Calhoun: The NPS Institutional Archive

DSpace Repository

Theses and Dissertations | 1. Thesis and Dissertation Collection, all items

1989-09

Survey and recommendations for the use of microcomputers in the Naval Audit Service

LaPoint, Tracy; Augustine, Michael

http://hdl.handle.net/10945/22534

This publication is a work of the U.S. Government as defined in Title 17, United States Code, Section 101. Copyright protection is not available for this work in the United States.

Downloaded from NPS Archive: Calhoun

http://www.nps.edu/library

Calhoun is the Naval Postgraduate School's public access digital repository for research materials and institutional publications created by the NPS community. Calhoun is named for Professor of Mathematics Guy K. Calhoun, NPS's first appointed -- and published -- scholarly author.

Dudley Knox Library / Naval Postgraduate School
411 Dyer Road / 1 University Circle
Monterey, California USA 93943

DUDLEY KNOX LIBRARY
NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA 93943-5002

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

SURVEY AND RECOMMENDATIONS FOR THE USE
OF MICROCOMPUTERS IN THE
NAVAL AUDIT SERVICE

by

Tracy LaPoint
and
Michael Augustine

March 1987

Thesis Advisor: James M. Fremgen

Approved for public release; distribution is unlimited.

T233145

unclassified
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION unclassified	1b RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b DECLASSIFICATION/DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION Naval Postgraduate School 6b OFFICE SYMBOL (If applicable) 54	7a NAME OF MONITORING ORGANIZATION Naval Postgraduate School
6c ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5000	7b ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5000
8a NAME OF FUNDING/SPONSORING ORGANIZATION 8b OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c ADDRESS (City, State, and ZIP Code)	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification) SURVEY AND RECOMMENDATIONS FOR THE USE OF MICRO-COMPUTERS IN THE NAVAL AUDIT SERVICE

12 PERSONAL AUTHOR(S) LaPoint, Tracy and Augustine, Michael

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Master's Thesis	FROM _____ TO _____	1987 March	179

16 SUPPLEMENTARY NOTATION

17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	microcomputer; auditing; audit management; audit software

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

This thesis studies ways in which the Naval Audit Service can adapt microcomputers and microcomputer software to audit and audit-related work. It discusses the introduction and implementation of microcomputers in the Naval Audit Service. It also surveys current software from three sources-commercial, government and public domain. During the software survey, it evaluates the usefulness of that software for Naval Audit Service audit applications. A survey of current audit practices using microcomputers was conducted in public accounting firms, audit departments in industry, the Naval Audit Service and federal government agencies other than the Naval Audit Service. Finally, this thesis makes recommendations for the implementation and efficient use of microcomputers in the Naval Audit Service.

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21 ABSTRACT SECURITY CLASSIFICATION unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL Prof. James M. Fremgen	22b TELEPHONE (Include Area Code) (408) 646-2644 22c OFFICE SYMBOL Code 54Fm

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted
All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE
unclassified

Approved for public release; distribution is unlimited.

Survey And Recommendations For The Use Of Microcomputers In The Naval Audit Service

by

Tracy LaPoint
GS-12, Naval Audit Service Capital Region
B.S., State University of New York at Buffalo, 1978

and

Michael Augustine
Lieutenant Commander, Supply Corps, United States Navy
B.B.A., Cleveland State University, 1976

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEMS

from the

NAVAL POSTGRADUATE SCHOOL
March 1987

ABSTRACT

This thesis studies ways in which the Naval Audit Service can adapt microcomputers and microcomputer software to audit and audit-related work. It discusses the introduction and implementation of microcomputers in the Naval Audit Service. It also surveys current software from three sources--commercial, government and public domain. During the software survey, it evaluates the usefulness of that software for Naval Audit Service audit applications. A survey of current audit practices using microcomputers was conducted in public accounting firms, audit departments in industry, the Naval Audit Service and federal government agencies other than the Naval Audit Service. Finally, this thesis makes recommendations for the implementation and efficient use of microcomputers in the Naval Audit Service.

72

THESIS DISCLAIMER

The reader is cautioned that computer programs developed in this research may not have been exercised for all cases of interest. While every effort has been made, within the time available, to ensure that the programs are free of computational and logic errors, they cannot be considered validated. Any application of these programs without additional verification is at the risk of the user.

TABLE OF CONTENTS

I. THESIS INTRODUCTION AND BACKGROUND 13

A. INTRODUCTION 13

B. BACKGROUND 13

C. SCOPE 15

D. METHODOLOGY 15

II. INTRODUCING MICROCOMPUTERS INTO AUDIT ORGANIZATIONS 18

A. INTRODUCTION 18

B. WAYS TO INTEGRATE MICROCOMPUTERS INTO THE ORGANIZATION 18

C. PROCESS AND PROBLEMS OF INTRODUCING MICROCOMPUTERS 19

D. CHANGES AS THE RESULT OF USING MICROCOMPUTERS 26

1. Effects of Introducing Microcomputers 26

2. Benefits of Introducing Microcomputers 28

3. People and Resource Policies 29

4. Objectives and Methods in Using Microcomputers 32

5. Constraints In the Microcomputer Operating Environment 33

E. NAVAL AUDIT SERVICE WORKLOAD 35

1. Audit Types 35

F. INTRODUCING MICROCOMPUTERS SUCCESSFULLY 43

1. General Implementation Strategies 43

2. Communicating Microcomputer Information to the Organization 44

3. Newsletters and Electronic Bulletin Boards 45

III. SOFTWARE SURVEY AND AUDIT SERVICE PROCESSES FOR MICROCOMPUTER AUTOMATION 47

A. INTRODUCTION 47

B. AUDIT SERVICE PROCESSES TO AUTOMATE 48
1. Work Papers 48
2. Spreadsheets and Analysis 51
3. Statistical Sampling 60
4. Report Generation 64
5. Internal Control 71
6. Planning and Controlling Audits 75
7. General Management and Administration Applications 81
8. Fixed Assets and Inventory 89
9. Database 91
C. INTEGRATED SOFTWARE 96
1. Introduction 96
2. Software Methods 97
3. Specific Software 98
D. MISCELLANEOUS USEFUL SOFTWARE 98
1. Forms Management 98
2. Desk Top Manager 99

IV. SURVEY OF CURRENT MICROCOMPUTER USE BY AUDIT ORGANIZATIONS 101
A. INTRODUCTION 101
B. SURVEY OF MICROCOMPUTER USE BY AUDITORS IN PRIVATE INDUSTRY AND THE FEDERAL GOVERNMENT 103
1. Background 103
2. Methodology 103
3. Results 104
C. SURVEY OF MICROCOMPUTER USE IN THE NAVAL AUDIT SERVICE 109
1. Background 109
2. Methodology 109
3. Results 110
D. PUBLISHED SURVEY ON MICROCOMPUTER USE 115

V. CONCLUSIONS 122
A. INTRODUCTION 122

B. SUMMARY AND RECOMMENDATIONS 122
1. The Process of Introducing and Integrating Microcomputers into the Audit Organization 122
2. Software Applications and Audit Service Processes 124
3. Survey of Current Microcomputer Use by Audit Organizations 124

APPENDIX A: GLOSSARY 127

APPENDIX B: FIGURES FOR CHAPTER III 129

APPENDIX C: PRIVATE INDUSTRY AND FEDERAL GOVERNMENT SURVEY PARTICIPANTS 164

APPENDIX D: THESIS SURVEY QUESTIONNAIRES 166

APPENDIX E: SOFTWARE DEVELOPMENT ORGANIZATIONS 172

LIST OF REFERENCES 174

INITIAL DISTRIBUTION LIST 178

LIST OF TABLES

1. FUNCTIONAL AREAS AUDITED BY THE NAVAL AUDIT SERVICE 40
2. MATCH OF AUDIT PROGRAMS TO FUNCTIONAL AREAS 41
3. SUMMARY OF COMPARISON OF SREADSHEETS 60
4. SUMMARY OF COMPARISON OF STATISTICAL PROGRAMS 64
5. SUMMARY OF COMPARISON OF TELECOMMUNICATION PROGRAMS 67
6. ADVANTAGES OF ICIS METHOD OF EVALUATING INTERNAL CONTROL SYSTEMS 74
7. SUMMARY OF COMPARISON OF PROJECT MANAGEMENT PROGRAMS 79
8. SUMMARY OF COMPARISON OF WORD PROCESSING PROGRAMS 89
9. SUMMARY OF COMPARISON OF DATABASE PROGRAMS 97
10. PRICE COMPARISONS FOR MICROCOMPUTER COMPONENTS 102
11. TYPES OF AUDITS PERFORMED BY RESPONDENTS 104
12. FUNCTIONAL AREAS AUDITED IN OPERATIONAL AUDITS 105
13. AUDIT PROGRAM USAGE BY SURVEY RESPONDENTS 105
14. MICROCOMPUTER APPLICATIONS USED BY RESPONDENTS 106
15. SOFTWARE USED BY THE SURVEY RESPONDENTS 107
16. MICROCOMPUTER USERS IN THE ORGANIZATION 108
17. WHERE MICROCOMPUTERS ARE USED 109
18. PREVIOUS EXPERIENCE IN USING MICROCOMPUTERS 110
19. PROBLEMS IDENTIFIED IN USING MICROCOMPUTERS 111
20. MICROCOMPUTER APPLICATIONS USED 112
21. ABILITY TO REUSE MICROCOMPUTER APPLICATIONS 113
22. ALTERNATIVES FOR INTEGRATING MICROCOMPUTERS 114
23. BENEFITS FROM USING MICROCOMPUTERS 114
24. POTENTIAL LEVEL OF MICROCOMPUTER USE 115
25. NAA SURVEY RESULTS 117
26. AUDIT ORGANIZATIONS SURVEYED 164

27. PRIVATE INDUSTRY AND FEDERAL GOVERNMENT QUESTIONNAIRE 166
28. NAVAL AUDIT SERVICE QUESTIONNAIRE 169

LIST OF FIGURES

2.1 Distribution of Direct Audit Hours by Audit Type 38
3.1 Sample Work Paper Template For Use During Contract Audits 129
3.2 DISKCAT Output Listings 130
3.3 Example Financial Profiles Using 1-2-3 131
3.4 Example Operations Summary Using 1-2-3 132
3.5 Example of 1-2-3 Used for Tallying Disbursing Officer Cash-On-Hand 134
3.6 Sample Session Using a Financial Modeling Program 135
3.7 Microstat Main Menu 137
3.8 EPISTAT Program Modules 138
3.9 1-2-3 Template for Random Dollar-Unit Samples 139
3.10 Upper Confidence Bound for Mean Sample Error 140
3.11 Data and Regression Output for Inventory Sample 140
3.12 Inventory Validity Regression 141
3.13 File Size vs Transfer Time 142
3.14 Comparison Ratio of File Size to Transfer Time 143
3.15 NAVAUDSVC Form 5220.1 Incorporated Into a Lotus 1-2-3 Spreadsheet 144
3.16 Sample Individual Time Report #1 145
3.17 Sample Individual Time Report #2 146
3.18 Sample Individual Time Report #3 147
3.19 Blank Consolidated Time Report Showing the Macro 148
3.20 Consolidated Time Report Showing Aggregate Data 149
3.21 Original Document Before Revision 150
3.22 Original Document After Revision 150
3.23 Output From FILECOMP.EXE 151
3.24 Microsoft Chart Graphics 152
3.25 PC-Graph Graphics 154
3.26 PC Project Manager Main Menu 155

3.27 Budget 156
3.28 Budget Graph 157
3.29 Completed Inventory Verification Work Paper 158
3.30 Graphic Display of Inventory Analysis 160
3.31 Sidekick Main Menu 161
3.32 PC-Deskmate Main Menu, Alarm Clock, and Calculator 162
3.33 PC-Deskmate Typewriter 163

ACKNOWLEDGEMENTS

We are grateful to the many individuals who assisted us in our search for information, provided helpful suggestions, and guided us while we developed this thesis. In particular, we thank the Auditor General of the Navy and all of his Regional Directors who generously gave their time and data during the research and information gathering phase. We are indebted to Captain Richard L. Bray, SC, USN, Mr. Gary L. Chester, and Mr. M. Bryant of the Navy Accounting and Finance Center, who provided us access to ICIS and gave us an understanding of how ICIS works. Lieutenant Commander Richard H. Feierabend, SC, USN and Captain Curtis W. Howes, USMC provided valuable programming and analysis assistance in developing the standard audit program library written in dBASE III Plus.

Most importantly, we sincerely thank Professor Fremgen for his patience, understanding, helpful critiques and deliberate guidance.

I. THESIS INTRODUCTION AND BACKGROUND

A. INTRODUCTION

The purpose of this thesis is to identify specific ways the Naval Audit Service can use microcomputers to increase the efficiency of accomplishing audit and audit management tasks. The tasks addressed in this thesis are performed on all types of audits and cover all areas of the audit process. The research emphasis is on how microcomputers can be used by all auditors to increase their productivity and quality of audit results. This thesis topic was proposed by Naval Audit Service headquarters personnel. Research was concentrated in four areas. These areas were (1) a review of alternatives for automating audit procedures and integrating microcomputers into the Naval Audit Service, (2) current software applications and programs available for auditing, (3) analysis of what audit procedures can be performed with microcomputers, and (4) microcomputer usage by auditors in public accounting firms, private industry, the Naval Audit Service and other federal agencies. There were specific areas of microcomputer usage that were not reviewed. These included hardware capabilities and configurations, training of microcomputer users, and security of hardware and software assets. Explanation of the technical aspects of automated data processing (ADP) and discussion of audit issues were also avoided in our research and final recommendations.

B. BACKGROUND

The Naval Audit Service is responsible for internal audit work performed in all Navy and Marine Corps activities. The Naval Audit Service's charter to perform such work is given in SECNAVINST 7510.7C. [Ref. 1] Internal audit is defined as review of programs for compliance with rules and regulations, adequacy of controls, and operational effectiveness. All organizational components and levels of Navy and Marine Corps activities are subject to Naval Audit Service review. Every aspect of these activities' operations are subject to audit by the Naval Audit Service. These audits are performed in regular intervals of three to five years. In addition, audits of selected functions are performed service wide and upon request by Navy and Marine Corps management.

Naval Audit Service is organized with its Headquarters located in Falls Church, Virginia and four regional offices. The regional offices are further subdivided into audit divisions composed of two or more audit sites and/or mobile audit teams. The audit sites are located at various Navy and Marine Corps activities both in the United States and overseas. There are approximately 600 auditors at these various locations. The auditors at the audit sites perform audits at those locations and geographically separate Navy and Marine Corps installations. The auditors are expected to perform all types of audits and are regularly transferred among various sites and audit teams, as needed. The audit work performed includes operational audits of activity functions and programs, financial audits of selected activities, and special reviews requested by Navy and Marine Corps management. The only exception to this generalist policy is in the area of data processing. Here special audit teams concentrate mostly on data processing audits. However, these auditors are not extensively trained in the area of data processing.

The Navy and Marine Corps are increasing their use of computers in all phases of their operations. This increased automation has changed the traditional audit trail, changed the types of data available and increased the quantity of data for review. These factors make the traditional manual review by auditors difficult and sometimes impossible to accomplish. Naval Audit Service's audit workload keeps increasing as the Navy and Marine Corps grow. Also, the increased emphasis on prevention and detection of fraud, waste and abuse requires thorough audits and timely reporting of results. In recognition of the change in the audit evidence and the potential for increase in audit productivity, Naval Audit Service started buying microcomputers for use by its auditors and audit managers. Previously, microcomputers were not used by auditors at audit sites or in the field. They were used in regional and audit service headquarters only. They were used for word processing, personnel management and tracking, and budgeting. Thirty-seven luggable IBM-compatible microcomputers were purchased in Fiscal Year 1986. It is anticipated that an additional forty-six microcomputers will be purchased. This would provide one microcomputer for about every five auditors. The hardware configuration of the systems purchased includes a central processing unit with 256K of Random Access Memory (RAM)[1] and two 5 1/4 inch floppy disk drives, a 10 megabyte hard disk drive and an external modem. Software purchased with the system includes an operating system, word processing,

[1]See Appendix A for a further explanation of RAM.

spreadsheet, statistical analysis, and data base packages. The Naval Audit Service purchased these microcomputers for use by their auditors and audit managers. They will be used for audit and administrative functions. In addition, the microcomputers will be used in a stand-alone mode as well as linked to mainframes. The microcomputers were placed in selected audit sites. Recipients of the microcomputers were not given special training prior to receiving the machines, and headquarters guidance concentrated on safeguarding the hardware and software assets. Currently, Naval Audit Service has no standard applications for use of the microcomputers and the auditors are left to develop applications on their own.

C. SCOPE

The objective of this thesis is to demonstrate how microcomputers can be used by auditors and audit managers in their daily operations. The Naval Audit Service wants its auditors and audit managers to utilize the microcomputers fully. Headquarters personnel are concerned that the microcomputers will be used only as word processors and on data processing audits. How to use microcomputers on all types of audits, covering all functional areas, is the primary concern of Headquarters personnel and this thesis.

To accomplish the objective, research concentrated on how ordinary audit practices and procedures can be performed on microcomputers. The procedures and practices considered are performed on all audits. While the research and recommendations of this thesis are aimed at the Naval Audit Service, any audit organization can apply the findings of this research to its use of microcomputers.

There were several areas concerning microcomputers and their use that were not considered. These included microcomputer security, hardware configurations, microcomputer to mainframe communication, acquisition methods and training methods. All these areas are important and should be considered by audit organizations before purchasing microcomputers. However, each one of these areas could be a separate topic for research.

D. METHODOLOGY

This thesis research was conducted within the framework of current microcomputer practices. Data were gathered from current accounting and computer literature, public accounting firms, private industry, federal government agencies and the Naval Audit Service. Data gathering techniques included surveys, interviews,

attendance at a Naval Audit Service management conference, software reviews, workload analysis and a literature review.

The process for introducing microcomputers into audit organizations is discussed in Chapter 2. Introducing microcomputers into an audit organization can affect the balance and performance of the organization. The policies, procedures and people required for smooth transition to the new technology are considered in this chapter. The policies and procedures for introducing microcomputers were determined from current literature on introducing change into organizations. Also, interviews with personnel from the Naval Audit Service and other audit organizations disclosed some methods and problems that should be considered. Naval Audit Service workload was analyzed for areas in which microcomputers could be quickly assimilated into the audit process. Finally, this chapter looks at alternatives for distributing information concerning microcomputers to the audit staff. In keeping with the objectives of the thesis, the methods evaluated can be used by all auditors for all types of audits.

A significant portion of the research was in the area of software demonstrations. Different types of software were obtained from commercial vendors, the public domain and federal agencies. The software capabilities were examined through live program testing and reviewing of the software documentation. In addition, the software was tested for it's usefulness in performing typical audit and administrative tasks. These tasks included both common audit tasks and ones unique to the Naval Audit Service. Where possible, actual audit applications were developed to test the software. Chapter 3 contains the results of our software review and recommendations for audit applications.

A survey was conducted on the use of microcomputers by auditors and audit managers. Participants in the survey included public accounting firms, private industry and federal government audit organizations. The extent of microcomputer use by auditors in other organizations was determined by this survey. A separate survey was sent to Naval Audit Service users of microcomputers. This survey provided an indication of how microcomputers are presently used in the Naval Audit Service. Also, it supplied information on the needs and problems facing Naval Audit Service users. The results of these surveys and the conclusions drawn from them are contained in Chapter 4.

The results of this research are summarized in Chapter 5. Also, this chapter contains recommendations for using microcomputers in the Naval Audit Service. The

potential benefits of using microcomputers for auditing and audit management are great. These benefits include increased productivity, the ability to sample more data, increased standardization of the audit process, increased timeliness and accuracy of audit results, and better utilization of audit resources. The recommendations included in this chapter do not pretend to be a comprehensive list. Also, some of the benefits listed above might be achieved in ways other than those discussed in this thesis. However, it is felt that the implementation of the recommendations contained in this thesis will improve the Naval Audit Service's use of microcomputers and the efficiency of the organization as a whole.

II. INTRODUCING MICROCOMPUTERS INTO AUDIT ORGANIZATIONS

A. INTRODUCTION

There are several areas an audit organization should consider before introducing microcomputers into its operations. Introducing any change into an organization will have an effect. Whether this effect is good or bad will depend upon how the change is planned, implemented and managed. In order for Naval Audit Service to integrate microcomputers smoothly into its organization these factors should be considered.

The integration of microcomputers into the Naval Audit Service will be a complex process. The decentralized organizational structure makes it difficult to monitor implementation and usage of microcomputers. Many of the audit sites are geographically separated from both regional offices and Naval Audit Service Headquarters. Thus, it is important that policies and procedures for microcomputer use are clear, documented, and understood by Audit Service personnel. Also, a method for distributing information about changes in policy, methods and developments in both hardware and software is needed. The framework for information distribution is already in place in the Naval Audit Service. How the microcomputers can be used in the audit process is another area that must be addressed for successful integration to occur. Pertinent questions include on which audits microcomputers should be used, what applications are needed and how these applications should be distributed throughout the organization. Finally, there are both physical and institutional constraints placed on microcomputer use in the audit process. These constraints must be identified and dealt with in order for successful integration of microcomputers into the Naval Audit Service. Alternatives available to the Naval Audit Service are discussed in this chapter.

B. WAYS TO INTEGRATE MICROCOMPUTERS INTO THE ORGANIZATION

It has been suggested that implementation of computer systems is equivalent to managing change within the organization [Ref. 2: p. 189]. Two basic forces exist that cause organizations to change--external forces and internal forces. External forces for change include (1) increasing workloads, (2) increasing costs, (3) changing technology, (4) changing perceptions of the beneficiaries of an organization's efforts, (5) changing

perceptions of appropriate behavior, and (6) others. Internal forces for change include (1) different organizational attitudes, (2) problems encountered in implementing new technology, (3) different strategies, (4) decrease in the number of members in the organization, (5) the resulting decrease in the experience level of the organization's members, (6) increasing workloads and work backlogs, (7) and dissatisfaction among organization members. [Ref. 3: pp. 379-380]

Management theories and studies about change in organizations recommend two major approaches. These two approaches to change are either piecemeal response to change as it occurs or programmed change as a natural evolution of the organization. [Ref. 3: p. 380] The piecemeal approach is satisfactory for minor change. But the planned program approach is mandatory for successful major changes in an organization. The planned program approach is defined as " . . . the deliberate design and implementation of a structural innovation, a new policy or goal, or a change in operating philosophy, climate, and style." [Ref. 4: p. 209]

C. PROCESS AND PROBLEMS OF INTRODUCING MICROCOMPUTERS

Strategic change refers to non-routine, non-incremental, and discontinuous change which alters the overall orientation of the organization and/or the components of the organization. [Ref. 5: p. 17] Introducing microcomputers into Naval Audit Service is an example of a strategic change. The volume of microcomputers purchased is significant and these machines provide users with a completely different audit tool than the tools used in the past. Thus, the ways in which audit and audit management tasks were previously performed are also changing with the introduction of this new audit tool. Naval Audit Service must manage this change. Managing change attempts to reduce the uncertainty associated with it. Presently, microcomputer users are uncomfortable with these machines and uncertain as to how to use them fully. In order to manage the change process successfully, three views of the change should be considered. These are the technical, political, and cultural views. Although introducing microcomputers is obviously a technical change, the other views are also necessary. A change in technology can impact the political and cultural aspects of an organization. The potential impact must be considered in order for the organization to effect the change smoothly. Successful change management involves three ingredients. These are (1) a diagnostic capability to probe potential future courses of action and determine the current state of the organizational and managerial affairs, (2) a capacity

for developing change strategies and selecting the appropriate organization and management techniques for carrying out the strategy, and (3) a cluster of skills and competencies required to implement and carry through the effort. [Ref. 5: pp. 20-21] The change process includes identifying intervention points, selecting intervention techniques, identifying conditions for success, developing an evaluation plan and developing a specific implementation plan.

The first ingredient of successful change management, diagnostic capability, will not be discussed here. The Naval Audit Service has already embarked on a change process. Therefore we will concentrate on developing the change strategy and how best to implement it. Change strategy is comprised of a change plan, appropriate change techniques, and the implementation process. The change plan is a general plan developed to tell what in the organization needs changing. It does not include how the change should be accomplished. This is covered in the implementation plan. The purpose of the change strategy is develop the desired future organizational state. The change strategy is similiar to the life-cycle management concept used in management of large projects in the Navy. In life-cycle management, the future state is developed in the mission analysis and program initiation phase. The techniques and methods for implementing the change correspond to events that occur in the concept development and definition/design phases of life-cycle management. Then actual implementation and evaluation of the change strategy are similar to events that occur in the deployment operation phase of the life-cycle management process.

The future desired state of the organization should consider the technical, political and cultural systems of the organization. These three systems must be in alignment for the change to be effective and the organization to operate smoothly. This is because these systems are not completely independent of each other. They are loosely coupled and a change in one of the systems could affect others. [Ref. 6: pp. 1-19] In order to develop a picture of the desired state, the organization should develop a statement of the types of changes needed in these three organizational systems. This statement should be in general terms. In addition to the general change statement a detailed description of the specific changes required in the various organizational components is needed. This includes changes in policy, procedures, management style, organizational networks, people and tools.

A change strategy alters the information processing capacity of the organization. [Ref. 5: p. 203] Technical change strategies involve changing organization components

to deal with uncertainty created by changing enivironment, technological developments or changing tasks. The organizational components include mission and strategy, tasks, organizational networks, people and processes. Each of these components should be reviewed to determine the amount of change needed to reach the desired future state.

The Naval Audit Service is facing technological change as the result of a new technological development--using microcomputers for auditing. This change requires adjustments in the tasks, people, processes and organizational network components. The task change required is the development of a long range plan which identifies the future state of the organization. The organizational network component is comprised of both the formal organizational structure and the informal networks developed by employees. Naval Audit Service organizational structure is not greatly affected by the introduction of microcomputers. The microcomputer is a tool for performing audits and does not affect workload types and sources of workload. Therefore, the distribution of auditors and audit sites should not be affected by introduction of the microcomputers. However, using microcomputer technology does require an increase in technical support provided to auditors. The Naval Audit Service user community is trained as accountants and in most instances does not have prior experience in using microcomputers. Microcomputers are not difficult to learn to use but can be time consuming and frustrating. The Naval Audit Service is concerned with usage rates. Technical support would provide users with answers to their questions and provide the auditor with a more positive feeling concerning microcomputer use. The framework for this technical support is already established within the Audit Service. Each region has an automated systems administrator. Currently this is the point of contact for questions concerning the microcomputer. However, this position is more concerned with protection of the assets than with providing guidance and solving problems related to the microcomputers. In addition, this position often is considered to be a collateral duty rather than a full-time job. Also, support is available from Naval Audit Service Headquarters. Again, this support is collateral support rather than full-time support. The Air Force Audit Agency's Small Computer Technical Center is one example of a microcomputer support organization.

Altering the organizational structure is probably the technical change strategy most often used. One way to alter the organizational structure is through the use of integrating mechanisms. Integrating mechanisms help the organization achieve coordination and control over its tasks and people. These mechanisms vary in both

cost and complexity. The goal of integrating mechanisms is to match simple low cost mechanisms with situations having low uncertainty and save the complex high cost mechanisms for high uncertainty cases. Galbraith categorized integrating mechanisms as simple measures (e.g. rules, hierarchy of authority), devices which decrease the need for information processing (e.g. creation of slack resources, creation of self-contained units), or complex mechanisms for increasing information processing capacity (e.g. vertical information processing systems and input-oriented relationships). [Ref. 7] The difficulty of implementing these mechanisms increases as one proceeds from simple to complex mechanisms.

Another method of technical change strategy is changing the people within the organization. This is accomplished either through the recruiting process or training and developing existing employees. Hiring people who possess the necessary skills is the quickest and most effective means of effecting the change. However, this option is not fully available to the Naval Audit Service. The hiring process is constrained by the number of vacancies in the organization and the Office of Personnel Management personnel rules. Such factors as ceiling points, job classisfications, and personnel registers limit the number of people who can be hired. Developing the skills of existing employees is a better option for the Naval Audit Service. The Naval Audit Service has a number of training courses available for its employees. Some of these are mandatory classes that are required at various points during every auditor's career, while the remaining training classes are selected by the auditors for their own career development. Development and inclusion of training classes in various aspects of microcomputer technology and use should be considered by the Naval Audit Service. These courses could be split between mandatory and optional ones. These courses would expose the auditors to the new technology and provide a base to build on.

Once the strategic change plan is developed then the organization must determine what to change first and how to effect the change. There are several alternative locations within the organization where the change can be initiated. Among these choices are top management only, organizational components that want the change the most, the components that need the change the most and new components created for the technology. Which of these is chosen is top management's decision.

After the starting point for the change is selected management must select the change approach. These are specific processes and procedures for changing the organizational behavior. [Ref. 5: p. 292] Current change technologies include open

systems planning; job design technologies, organizational design technologies, team development, quality control circles, and career development. A combination of these various technologies appears to be the best way to integrate microcomputers into the Naval Audit Service. Some open systems planning is needed to define the future demands on and responses to microcomputer technology in the Naval Audit Service. Open systems planning involves defining the organizational mission and identifying current and future factors that could affect the organization's ability to carry out the mission. These factors occur both inside and outside the organization. Based on this analysis, methods can be developed to alter or control these factors.

Obviously the job design technologies are needed to change how audit tasks are performed. The microcomputer is a potentially powerful audit tool that eventually will change the productivity of audit work and the way in which audits are performed. The Naval Audit Service needs to develop procedures and policies for altering the traditional audit work procedures to take advantage of the microcomputer. However, this work process redesign should be accomplished in conjunction with the upgrading of the auditor's microcomputer skills.

As previously discussed, the various organizational design technologies should be used to integrate the microcomputers into the audit process. These procedures include developing technical support groups at both regional and headquarters level, establishing rules and procedures for microcomputer use, and developing a microcomputer newsletter for the Audit Service as a whole. The technology used for integrating microcomputers, whatever it may be, should be documented and announced so that users understand it.

Team development technology affects both organizational processes and people. Team development is based on the action-research approach to change. This approach involves the orderly collection of data on organizational problems and the use of the data for solving these problems. The data collection and feedback occur on an on-going basis so that organizational members can make changes, evaluate the outcomes of the changes, and make new changes. The objective of team developemnt is to provide the team members with the knowledge and skills to allocate workload, adapt the work process, and facilitate decision making, problem solving, and communications.

Quality control circles are a recent change technology. Groups of employees are brought together periodically to come up with solutions to organizational problems.

The proposed solutions are then communicated to management for their consideration and action. The Naval Audit Service uses this technology during the annual "all-hands" conferences held by each region. Also, the quarterly directors conferences use quality control circles to air organizational problems and issues. However, these meetings are not conducted frequently enough to be of much benefit in integrating microcomputers into the Naval Audit Service.

The change technology to use depends upon several factors. The first factor is the identification of which organizational component needs changing. Some change technologies are better suited for a particular component than others. The organization should understand the change technology chosen. What the technology does, how it does it and the underlying assumptions must be understood. Also, some form of cost/benefit analysis should be performed before the technology is selected. Other factors to consider before selecting the technology include the depth of the needed change (individuals versus processes) and the conditions needed for the technology to work. After the specific change technology is selected the implementation plan is developed. The plan should include the participants, the manager of the change, a time table for activities, and the resources needed.

The organization goes through a transition period while moving to the desired state. Effective management of the transition is needed for successful implementation of the change. Management should define the transition state as separate from the present or future state, determine the most effective form of management, set up this management structure and communicate this structure to the organization. [Ref. 8: pp. 48-49] This structure could be a project manager, existing hierarchy, a group of influential leaders, or a group of people from different levels and departments in the organization. The transition manager uses the implementation plan to manage the change.

Even though the forces that cause change are numerous, powerful resistance to change exists in all organizations. For every proposed change, there are, invariably, forces that encourage maintenance of the status quo. There are many reasons for resistance to change. A few of these reasons are (1) socio-political losses of authority, power and corporate territory, (2) perceived, potential job loss, (3) fear of new things, including fear of learning to use computers and fear of computers themselves, and (4) structural inertia within the organization (i.e., that's the way it's always been done!).

The change process must be monitored and evaluated during it's execution. The purpose of the monitoring and evaluation is to determine if the change effort is worthwhile, has resulted in the desired changes, and is preventing the new state from slipping back into the old. These issues should be addressed when the change plan is developed. The change management must develop some form of measuring these issues for the evaluation to be meaningful. The people involved in the change must understand the the evaluation process and the measures being used. Some Naval Audit Service managers are already concerned about the ill effects of measuring productivity from microcomputer use when the majority of users are untrained in exploiting the benefits of the microcomputer. A good evaluation plan will provide change managers with information about the change progress. This will result in a better managed change.

Overcoming resistance to change requires a strategy that overcomes the resistance and implements the planned change. Empirical studies have found that the following factors substantially impact the success of computer implementations:

- Support from top management
- Clear perception of a need
- A definite problem to solve
- Early user commitment and staff support [Ref. 2: p. 196]

Practitioners have lent practical credence to the findings of the empiricists. David Freedman, a practitioner writing about his own experiences, relates that microcomputer introduction and subsequent, successful integration into the audit organization depends on the cooperation of key personnel, not only from top management but from all of the levels in the organization where microcomputers will be approved and used. The integration effort should be a team effort. Involvement in this team effort must begin at the top levels of management. The top management should be involved for two reasons. First, the organization needs top management's approval to obtain microcomputer resources. Fortunately in the case of the Naval Audit Service, the microcomputer resources are already available. Second, top management's involvement is required in order to set and maintain an organizational attitude that is conducive to using microcomputer resources to their fullest capacity and that is conducive to maintaining the resource at the highest level of the current technology, consistent with budget limitations and the mission needs of the Naval Audit Service. From top management, involvement in the integration team effort

should follow through the audit managers to the auditors, who are intended to be the primary users of this new audit tool. If they are included in the integration of the microcomputer, they will feel that they had an important voice in the selection and use of their own audit tools and thus should be more receptive to actually using the microcomputer, instead of letting it sit unused. A representative of the Data Processing (or Management Information System) department is also an appropriate participant; he or she can lend unique technical expertise and advice--if the chosen Data Processing representative can relate to the team and use minimal computer jargon. [Ref. 9]

The clear perception of the need for microcomputers by those holding budget and contract authority in the Naval Audit Service is obvious from the level of Naval Audit Service procurement of microcomputers. However, the perceived need for these microcomputers by the intended users may not be universal throughout the Naval Audit Service. If the need perception is not universal, then microcomputer use might not be universal. Unused microcomputers are wasted resources.

Problem solving, in a team setting, provides an opportunity to break down resistance to the change to microcomputers. Teamwork involves users in decisions. Negotiation and listening provide a forum in which organization members may express fears and be assured that these fears are unfounded (or, confirm that their fears will become reality and develop mechanisms to cope with the forthcoming reality). [Ref. 9]

Conscious involvement by top management (and top management staff) can help break down resistance to change by providing an authoritative channel of communication where user feedback can be seriously considered so that microcomputer introduction is performed in ways that allay fears, make audit tasks easier, and increase job efficiency. [Ref. 9]

D. CHANGES AS THE RESULT OF USING MICROCOMPUTERS

1. Effects of Introducing Microcomputers

The introduction of microcomputers is potentially the single, most significant office productivity development since the typewriter.

> Microcomputers have the capacity and sophistication necessary to perform tasks that previously either required the power of much larger computers or simply could not be accomplished economically by a computer of any size. Micros can be used effectively in a matter of hours by individuals possessing little or no computer training . . . . [Ref. 10: p. 1]

Microcomputers or, more accurately, microcomputer software can lessen the reliance on pen and paper in the office environment. The microcomputer is automating the desktop, like machinery automated the factory.

> Executives and managers as all levels increasingly use microcomputers to prepare budgets and forecasts and complete other time-consuming tasks that were previously performed manually. Microcomputers are now routinely used to prepare financial statements, compile . . . statistics, maintain records and perform word processing. In short, the microcomputer promises to automate the desktops of office workers, eliminating much of the need for pencils, paper and adding machines . . . . [Ref. 10: p. 1]

Some individuals would argue that office automation, and microcomputers in particular, are nothing more than today's continuing aspect of the industrial revolution that began with the mechanization of hand-manufacturing processes and that automation is merely the sophisticated extension of factory mechanization into the office. [Ref. 11: Abstract] However, along with the introduction of the microcomputer, introduction of different methods of internal control are needed. The introduction of microcomputers into an audit organization does not lessen the need for the people of that organization to conduct audits in accordance with generally accepted auditing standards and government auditing standards. Nor does the introduction of microcomputers lessen the need for auditor judgement. On the contrary, the auditor using the microcomputer as an audit tool must know the capabilities and limitations of the tool. The auditor must also understand and correctly interpret the output generated by the microcomputer in terms of the context of audit findings and intended audit objectives. The potential for incorrect results from the microcomputer is as correspondingly great as the potential for increased efficiency and accuracy.

> Microcomputer users report less segregation of duties because one person commonly performs the functions of user, programmer, systems analyst and computer operator. Another area of concern is the casual operating environment . . . this contrasts sharply with the mainframe environment. Controls over program changes, system documentation, backup and recovery plans, data approval, validation checks, and systems testing still need to be implemented in many microcomputer applications . . . .Questions most frequently asked are

- Is microcomputer technology a passing fad?
- Does everyone in the organization need a microcomputer?
- Can microcomputers really be used effectively by employees?
- Are detailed management policies and centralized controls necessary?

- How do microcomputer systems interact with other computer systems?
- Are data security and data integrity real issues?
- Is everyone in the organization using the same (consistent and up-to-date) data?
- Are we getting the most for our money from these machines? [Ref. 10: p. 2]

With 1984 projections of 2.8 million microcomputers in offices, it is a certainty that microcomputers are not a passing fad [Ref. 10: p. 1]. Each organization must decide for itself whether or not each individual should have his or her own microcomputer. This and the next chapter, will attempt to demonstrate, by using specific examples and programs, that microcomputers can indeed be used effectively by the employees of the Naval Audit Service. The necessity of detailed management policies and controls will be discussed further in the succeeding pages of this chapter. Microcomputer systems interaction with other computer systems (i.e., mainframe systems) is beyond the stated scope of this thesis. Therefore, no attempt will be made to answer the last two questions relating to data consistency and return on investment. Rather, attributes that may be used to answer these last two questions will be identified.

2. **Benefits of Introducing Microcomputers**

Clerical staffs, including auditors, have been the last areas of industry and government to receive mechanization and automation. Until recently, clerical staffs have been a small part of organizations (government excepted) and the cost of clerical inefficiency has been easily absorbed in the greater sum of the organization. As clerical staffs continue to grow in terms of numbers and salaries, clerical inefficiency becomes harder for the organization to absorb. Inefficiency in the office environment is sometimes difficult to measure. Much of the auditor's work is judgemental, heuristic, subjective, and dependent upon the auditor's experience. In addition, each audit may be different from the last and may require unique actions. These actions may be difficult to standardize or repeat over several audits when those audits are conducted under dissimilar requirements and constraints.

> Inefficiency in the office is not always obvious. Much of the waste and inefficiency in clerical procedures is hidden. It is seldom as perceptible or dramatic as the scrap pile or the shutdown machine. Neither casual observation nor normal accounting reports make it obvious. [Ref. 12: p. 3]

Clerical inefficiency must be eliminated, and the microcomputer offers possibilities for cost reduction and efficiency increases. However, automation is not a cure-all for office or auditor inefficiency, but some of its benefits are as follows:

- Increased efficiency -- this does not mean 100% efficiency!
- Improved methods of operating in the field and at the central office
- Reduced physical effort and improved work environment
- Enhanced quality of audits and reduced risk of overlooking material items
- Increased capacity and thus better ability to keep up with external demands for more audit work
- Pride in owning the latest, state-of-the-art auditing tools [Ref. 11: pp. 83-84]

3. **People and Resource Policies**

a. Planning for the Introduction and Use of Microcomputers

Planning for the introduction and use of microcomputers should be done to prevent excess equipment and incompatible hardware and software. Such uncontrolled proliferation could harm the organization's microcomputer system compatiblility and ability to exchange data and programs across microcomputers. Management planning for microcomputer systems should at least address these areas:

- Which micro/software combination(s) best meet user needs?
- How is maintenance for microcomputers and related peripheral equipment going to be provided?
- How will user training be provided?
- Should relatively expensive peripheral equipment be shared?
- Should microcomputers have the ability to communicate with one another?
- Have data security issues been considered?
- Should microcomputers be allowed to access larger computers within the organizations?
- How can new technological advances be anticipated? [Ref. 10: pp. 20-21]

When developing plans for microcomputers, the following aspects are pertinent considerations:

- User requirements for information processing.
- The priority of the identified information processing requirements.
- Hardware and software that will meet information processing requirements.
- Timetable for introduction and implementation of microcomputer systems and applications.
- Future information processing requirements.
- Management policies necessary to ensure that microcomputers are utilized effectively and information is safeguarded adequately. [Ref. 10: p. 21]

b. Management Policies and Guidance to the Organization

The microcomputer is an individual productivity tool. As such, it can allow the individual user a certain degree of enhanced creativity and application of initiative. Yet from another aspect, today's powerful microcomputers are capable of affecting the data, procedures, and operations of the entire organization. From these perspectives then, management policies toward the microcomputer systems should attempt to strike a balance between the individual's creative need, which is healthy for the organization, and the organization's need to control its own processes.

> Although it is true that much of the office work being performed today with microcomputers is similar to that previously done manually, the technology presents risks not found in more traditional manual environments. Micros can process information significantly faster than can humans and are capable of storing tremendous volumes of data, making it much easier to modify, destroy, or remove sensitive data. More importantly, microcomputer systems often evolve to encompass more complex applications, such as data communications, that can affect an entire organization. For example, providing unrestricted, uncontrolled access to data maintained on an organization's mainframe or minicomputer system presents obvious data security risks . . . .Management policies are necessary to fully capitalize on the unique characteristics of the microcomputer and to ensure that productivity is maximized. The breadth and scope of the necessary policies will depend on the needs of the organization and how its microcomputers are being used. The most effective manner of communicating policies in this area seems to be to set them forth in writing and distribute them to users in the form of a user's manual or microcomputer guide . . . . [Ref. 10: p. 22]

The Department of the Defense Inspector General has published guidance on using computer technology in auditing. The guidance is directed to defense internal audit, internal review and military exchange audit organizations. Only one section of the chapter on Computer Assisted Audits contains mandatory guidelines for audit organizations. [Ref. 13]

The mandatory policies include:

- Establish a program for integrating computerized techniques into the audit process. The program should identify and test new audit applications, provide technical assistance to the audit staff and publicize computerized audit techniques.
- Encourage planning for the effective and efficient use of available computer resources to increase auditor productivity and improve the quality of audit products. The need for microcomputers to aid the audit function will be assessed and requirements developed to support budget requests for computer resources.
- Implement effective controls and oversight over use of computerized techniques to help ensure that reliable and accurate audit results are obtained. The controls shall address the adequacy of (a) data entry and verification processes, (b) data management practices, (c) audit software application development, testing, and documentation procedures, and (d) supervisory reviews and approval of computer generated analyses.
- Ensure information security policies and procedures for protecting sensitive data are followed when this data is retrieved, processed or stored during a computer assisted audit.

- Develop and implement training programs to provide auditors the opportunity to become familiar with, or proficient in the effective use of computers in conducting audits. In addition, audit managers and supervisors will become familiar with the capabilities of computer software used by their staff.
- Document computer use in performing an audit in the audit working papers. This documentation should allow the reviewer to recreate the computer process. Develop procedures for retaining and storing electronic workpapers and other automated evidence used in support of the audit report [Ref. 13: pp. 3-5].

The remainder of the instruction discusses policies and procedures audit organizations should consider while using microcomputer technology in performing audits. The topics discussed include:

- Front end planning of computer resource use on audits--the planning should cover availability of computer resources, where audit productivity can be increased through computer use, skill level of the audit staff and environmental factors that could affect the use of computers.
- Data entry techniques and procedures used for computer audits--topics covered include direct data entry and downloading data from other computer systems.
- Data management to ensure data integrity.
- Data verification procedures for ensuring reliability of source data and accuracy after data entry.
- Software controls that ensure programs and specific applications are operating correctly and perform as intended.
- Quality assurance over computer auditing techniques and results.
- Automated working paper standards. [Ref. 13: pp. 3-5].

Audit organizations are responsible for implementing the mandatory and optional procedures. This instruction contains only general guidance and does not discuss specifics of implementation.

The Naval Audit Service has initiated some policies and procedures to comply with DoD's mandatory guidelines. The emphasis of these policies are in the areas of hardware and software asset protection. Each region has appointed a Regional Automated Systems Administrator. The responsibilities of this posistion are to maintain an inventory of hardware and software assets, assist auditors in using microcomputers, and collect usage statisitics from the audit sites with microcomputers. In addition, the Naval Audit Service Western Region has required that microcomputer needs and requirements be projected for all audits scheduled during the fiscal year. [Ref. 14] The Naval Audit Service is developing procedures and policies for the remainder of the mandatory guidelines.

c. Microcomputer Software Acquisition Policies

Software acquisition is the most important consideration in procuring microcomputer systems because the software is the system component that makes the microcomputer useful. Compatibility is paramount to the easy exchange of information. Re-keying of data and re-writing of findings will be required to produce a final, consolidated audit report if each auditor uses incompatible software during fieldwork. [Ref. 10: p. 23]

Selecting particular software can be confusing. The software market presents a bountiful table for the microcomputer user. However, the buyer must beware! Software varies by vendor as to price, quality, purpose, guarantee, and proven performance. The following are some ways to increase the probability of selecting good quality software:

- If at all possible, stay with the market leaders. Programs that have achieved widespread acceptance are generally reliable. . . .
- Place heavy emphasis on user-friendliness. . . .
- Seek evaluations from other users . . . .Check with similar . . . organizations and review references from hardware and/or the other software vendors . . .
- Test software thoroughly! . . . [Ref. 10: p. 25]

4. Objectives and Methods in Using Microcomputers

The microcomputer is primarily a personal work station. Accordingly, objectives and methods for using microcomputers should be oriented toward the individual in the organization. Many procedures are susceptible to automation. But susceptibility does not necessarily mean preferability. Before automating a procedure, evaluate the usefulness of that procedure in both the manual and the automated format. It may be that automating a particular procedure does not add anything to efficiency. [Ref. 12: p. 6] And, although microcomputers are more flexible than mainframe computers, they still require discipline in following organizational plans and policies designed for efficient and effective use of microcomputer systems.

A study conducted in the 1950's by the Harvard Business School found that many companies automated their processes primarily to increase capacity--not to decrease costs. Decreasing costs was a secondary reason for automating. [Ref. 11: p. 83] At a recent conference, Naval Audit Service management estimated their workload at 50 years, with current staff levels. So, the reasons of 30 years ago for automating factory processes are still valid and applicable to automating clerical procedures. The primary objective is still increasing the capacity to perform work. The objectives of

automation applied to microcomputers can be summarized in the following advantages and disadvantages:

Advantages

- Increased capacity and ability to expand production with little or no additional infusion of labor
- Reduced direct labor content of tasks
- Shorter lead times for task accomplishment
- Less wasted effort (i.e., greater effectiveness)
- Higher productivity
- Increased utilization of available resources
- Improved morale
- Increased flexibility
- Less training required
- Shorter set-up time, on-site

Disadvantages

- Higher capital investment
- Higher maintenance costs
- Longer design-time
- Troublesome de-bugging during the start-up period
- Serious compounding of downtime, without proper planning
- Need for enhanced skills in using new microcomputer tool
- Need for greater understanding of processes involved in generating output and how to interpret that output based on the input
- Reluctance or inability of some members of the organization to adapt to microcomputers [Ref. 11: p. 80]

5. **Constraints In the Microcomputer Operating Environment**

a. Physical Constraints

Microcomputers are not universally useful. Their most obvious limitation is their requirement for electricity to operate, followed by their sometimes awkward physical dimensions and weight. The auditor should consider the following factors when deciding to employ a microcomputer:

- Availability of electricity in the correct voltage, type of current, and convenient location
- Necessity for proper identification of the equipment and its carrier for access to controlled military facilities
- The storage and manipulation of classified information and the need for machine certification for the level of classified information to be used
- Requirements for a table or desk for the microcomputer

- Requirements for a telephone line with appropriate connectors for a modem and a telephone handset
- Proper packaging to protect the microcomputer from damage in shipment if carried on a common carrier while travelling and any excess baggage charges
- Provisions for carrying cumbersome, 'luggable' microcomputers that weigh 25 to 30 pounds
- Security precautions to prevent loss from theft, or damage due to carelessness
- Protection against extreme temperatures

b. Operating Constraints During Downtime

Management should develop a plan of action to prevent cessation of operations when a microcomputer fails to operate or malfunctions. The easiest protection against work stoppage due to microcomputer malfunction is to have a spare microcomputer on-hand and ready to use in place of the failed unit. With the variety and dependability of overnight package delivery services in most areas that the Naval Audit Service works, travelling audit teams may depend on overnight delivery of a spare unit from a central location, rather than carrying a spare with them. The low cost of microcomputers makes this a feasible alternative for the Naval Audit Service. This requires that the auditor, or some member of the audit team, be knowledgeable enough to make the proper connections to set up the spare unit. It may also mean removing the hard disk unit from the failed unit and installing it in the spare unit. Travelling auditors might consider carrying a small tool box as part of the microcomputer hardware. Also, the auditor-in-charge should have a pre-determined plan of alternate tasks that can be accomplished manually while waiting for the spare unit to arrive, or the broken unit to be repaired.

Normal preventive maintenance on microcomputers will inevitably have to be performed if the units experience any kind of prolonged use. This maintenance should be scheduled during anticipated idle periods to prevent disruption of audit operations.

The adverse impact of downtime manifests itself in loss of productive time and could have a cumulative effect on the entire audit, not just the current task being performed. This adverse impact can be minimized by appropriate planning. [Ref. 11: p. 151]

c. User Constraints

Finally, the average microcomputer user does not have, and probably should not have, a detailed understanding of the inner workings of the microcomputer

hardware and the software. However, this does not relieve the auditor of the general responsibility for maintaining the quality of the audit results when using the microcomputer in the conduct of the audit. Auditors who are unfamiliar with microcomputers may not recognize problems as they occur. Errors introduced to a microcomputer are automatically multiplied throughout the rest of the automatic analysis. [Ref. 15: p. 1]

E. NAVAL AUDIT SERVICE WORKLOAD

The Naval Audit Service is responsible for audits of all Navy and Marine Corps activities and functions. This covers all aspects of their operations. The auditors are located at various Navy and Marine Corps operations througout the world. The workload is divided into audit tasks and administrative tasks. Audit tasks are performed by auditors and audit managers to satisfy the audit objectives. Administrative tasks refer to recurring requirements that are performed throughout the year regardless of the specific audit. An analysis of the Naval Audit Service workload is contained in this section. The objective of this analysis is to determine the best way to assimilate microcomputers into the work process.

Audit tasks refer to the planning, performing, analysis, and write-up of the final audit report. Chapter 3 of this thesis contains specific examples of microcomputer applications for performing audit processes. Microcomputer technology is ideal for repetitive tasks. Once a software application is developed it can be used every time that specific audit step is performed. The Naval Audit Service's workload was analyzed for the amount of repetition and similiar tasks it contained.

The Naval Audit Service's workload is categorized into several different types of audits. Descriptions of some of the audit types and their objectives are as follows:

1. Audit Types

a. Activity Audits (Identified as "A" and "B" audits)

These audits determine the compliance with laws and regulations and evaluate the internal controls in place at one location. These audits are performed on a regular schedule generally every three to five years. These audits are usually performed by a mobile audit team unless there is a Naval Audit Site located at the activity. [Ref. 16: para 302]

b. Continuous Audits (Identified as "C" audits)

These are activity audits that are separated into phases and performed on a continuous basis by a resident audit staff at an audit site. Activities selected for continuous audit coverage are major ones at which a heavy volume of work is required. Each audit phase covers one or more functional areas cyclically to produce comprehensive coverage of functions of audit interest. These audit phases are performed on a three to five year schedule. [Ref. 16: para 302.4]

c. Concurrent Audits (Identified as "A", "B", or "C")

These are audits of similar functions performed at similar activities (e.g. all or most shipyards or supply centers). The purpose of these audits is to assess conditions more effectively and consistently on a Navy-wide basis. These audits are performed on an as-needed basis. [Ref. 16: para 302.5]

d. Intra Department of the Navy Multilocation Audits (Identified as "T" audits)

These audits provide concurrent coverage of a problem, program, or function at two or more activites. The purpose of these audits is to achieve a regional or service-wide assessment of performance trends and accomplishments. The audit is normally coordinated by a single regional office for all regional offices. The coordinating office is responsible for consolidating the findings and publishing the audit report. These audits are performed on an as-needed basis. [Ref. 16: para 303]

e. System Reviews (Identified as "D" audits)

These audits include a review of operational and developmental automated systems. The audit objectives are (1) to appraise the adequacy of controls, (2) to verify compliance with applicable standards, regulations, and design specifications, (3) to review system documentation, and (4) to assess the efficiency and economy of system operations or developmental efforts. They are performed on an as-needed basis. [Ref. 16: para 305.1]

f. Project Management Reviews (Identified as "K" audits)

These audits assess the effectiveness of the management and control of major procurement projects in the Navy. The audit objectives are to ensure compliance with requirements and regulations relating to contractual procurement. These audits are normally only performed by the Capital Region which is located in Washington, D.C. [Ref. 16: para 305.2]

g. Unannounced Disbursing Audits (Identified as "X" audits)

These audits are done on a surprise basis and include a verification of the disbursing officer's cash account as well as an evaluation of the officer's verification program. A comprehensive review of the disbursing operation is performed only when the verification program is considered inadequate. Normally, comprehensive reviews of disbursing operations are part of activity audits. [Ref. 16: para 305.3]

h. Command Request Audits (Identified as "S" audits)

These audits originate as the result of a written request received by the Naval Audit Service from a command. The request includes the size, scope, and urgency of the audit. In addition, the request states whether the work is in the purview of an audit or requires another type of assistance. [Ref. 16: para 306]

i. Commercial Activity Reviews (Identified as "V" audits)

These audits certify in-house cost estimates for commercial activity type functions that exceed threshholds establshed by the Secretary of the Navy. These audits substantiate the currentness, reasonableness, and completeness of those estimates as required by OMB, DOD, and DON guidance. [Ref. 16: para 308.2]

j. Investigative Assists (Identified as "J" audits)

These audits involve assisting investigative organizations (e.g. NIS and the FBI) and are performed under the auspices of the requesting investigative organization. The work consists of performing audit-like tasks on cases under investigation. These audits are performed on an as-needed basis. [Ref. 16: para 308.1]

k. Audit Research (Identified as "Q" audits)

These audits determine the feasibility of an audit in a particular activity or functional area. Background data are gathered and analyzed to determine the need for audit in that area. These audits are performed on an as-needed basis. [Ref. 16: para 308.4]

The above audit types accounted for almost 94% of the Naval Audit Service's Fiscal Year 1986 audit workload. [Ref. 17] As shown in the graph in Figure 2.1, activity, continuous, special request and multilocation audits accounted for approximately 82% of the work. Unfortunately, a breakdown of workload by audit type does not provide much guidance on where microcomputers can be used best. These audit types only provide a general definition of the audit workload.

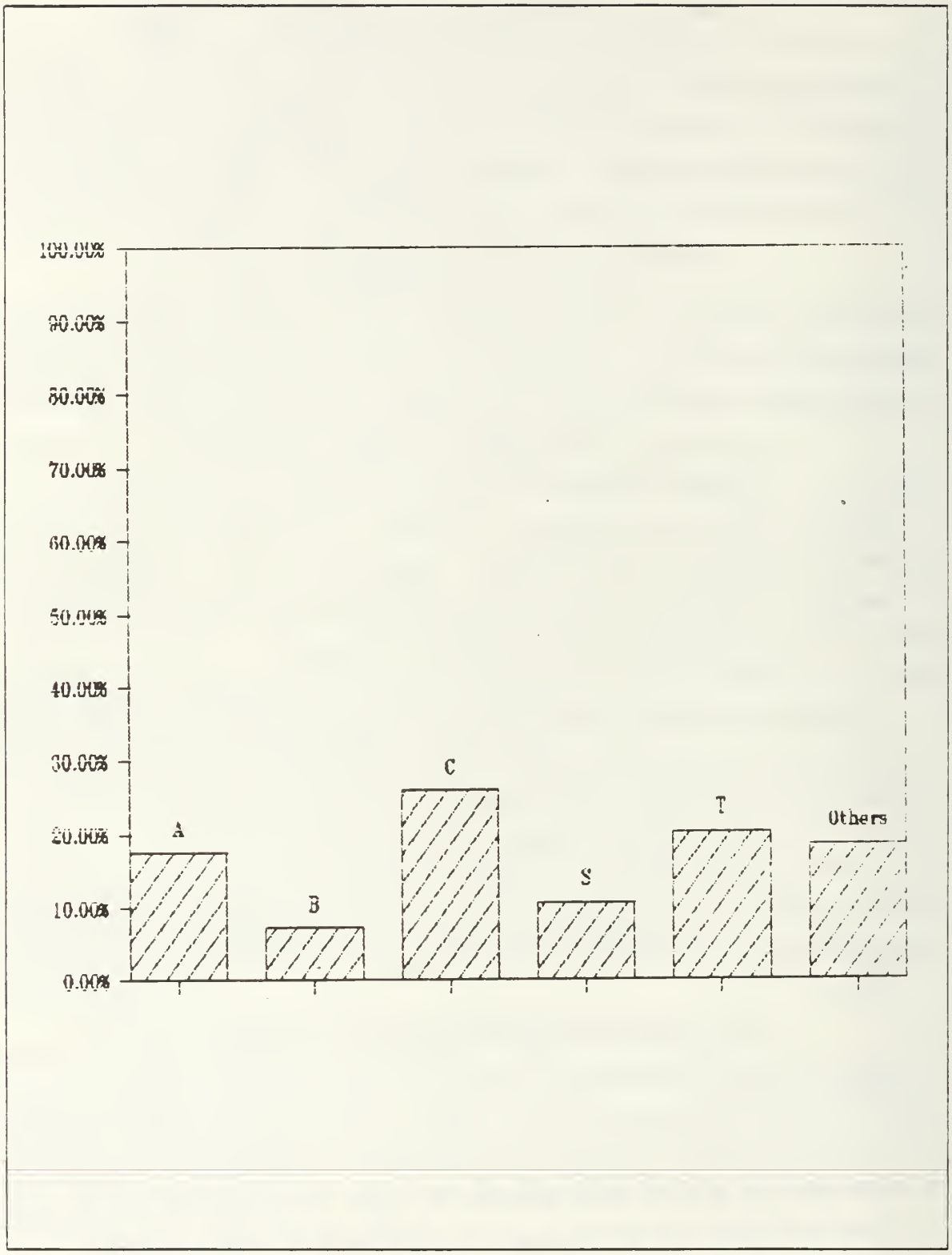


Figure 2.1 Distribution of Direct Audit Hours by Audit Type.

Another workload breakdown is provided by the functional areas to which auditors charge their time on the bi-weekly timesheets. The Naval Audit Service has 35 work measurement codes that are used to identify direct audit hours worked on an audit. A list of the work measurement codes and functional programs is contained in Table 1. In fiscal year 1986 all 35 of these work measurement codes were charged with audit hours. However, only two of the work measurement codes contained over 10% of the total auditor and auditor-in-charge man-hours for the Naval Audit Service. These two functional programs were Other Comptroller and AIC Planning, Supervising and Review. Naval Audit Service workload is so diverse that there were only five other functional programs which had more than 5% of the total organization's auditor and auditor-in-charge direct work hours charged to them. These five functional programs were Contract Administration, Rebuild and Overhaul of Equipment, Supply Operations Retail, Information Technology, and Investigative Support. [Ref. 18] This diversity of workload makes it difficult to identify specific areas in which microcomputer technology can be concentrated to provide the most benefit to the organization. However, this information can be used to identify functional areas in Naval Audit Service standard audit programs which should be reviewed for potential automation.

The Naval Audit Service has 44 standard audit programs for use by its auditors. These programs list specific audit steps to perform for an audit and are the auditors' primary tool. These programs also provide a checklist for reviewing compliance with laws and regulations applicable to the functional area program or issue. Audit programs are developed for various functions and programs audited on a recurring basis. In some instances programs exist for a particular audit type (e.g. Audit Program #43, Project Management Audits). However, most programs are used on a variety of audit types. In addition, some audit types (e.g. Multilocation ("T") Audits and Special Request ("S") Audits) require that a specialized audit program be developed each time an audit is performed.

Currently, the Naval Audit Service does not track audit program usage by specific audits. Thus, it is not possible to determine which programs were used most. An attempt was made to correlate audit programs to specific functional areas. The standard audit programs were matched to the appropriate functional areas where possible. The results are shown in Table 2. This analysis does not provide an accurate breakdown of specific workload, since programs are used on several different functional areas. In addition, several different programs may be used for one functional area.

TABLE 1

FUNCTIONAL AREAS AUDITED BY THE NAVAL AUDIT SERVICE

Code	Function
01	Research and Development
02	Test and Evaluation
03	Major System Acquisition
04	Procurement - Inventory Control Activities
05	Procurement - Research and Development
06	Procurement - Other
07	Contract Administration
08	Forces Management
09	Maintenance and Repair of Equipment
10	Rebuild and Overhaul of Equipment
11	Manufacturing and Production
12	Supply Operations - Wholesale
13	Supply Operations - Retail
14	Property Disposal
15	Civilian Personnel Management
16	Military Personnel Management
17	Real and Installed Property
18	Construction
19	Information Technology
20	Intelligence and Security
21	Communications
22	Transportation
23	Military Pay and Benefits
24	Civilian Pay and Benefits
25	Program and Budget
26	Other Comptroller Functions
27	Support Services
28	Nonappropriated Fund Activities
29	Security Assistance Program
30	Commercial Activities
31	Investigative Support
32	Health Care
33	Not Used
34	Other
35	AIC's Planning, Supervision and Review
36	Assistant Director's Planning, Supervision and Review

The Naval Audit Service's workload is so diverse that developing standard microcomputer audit applications will be difficult and will require a great deal of time. Even then all audits will not have a base of applications for use. Probably the best way to divide and categorize Naval Audit Service workload is by the activity audited. Currently, there are continuous audit sites at several different types of activities. There are sites at six headquarters activities, two inventory control points, six integrated aeronautical complexes, eight Naval Shipyards, and four Supply Centers. The remaining sites are at unique Navy and Marine Corps

TABLE 2

MATCH OF AUDIT PROGRAMS TO FUNCTIONAL AREAS

Function	Number of Programs
01	1
03	1
04	1
05	1
06	2
07	4
09	3
10	3
12	2
13	2
15	1
17	4
18	1
19	4
20	1
21	1
22	3
23	1
24	1
25	1
26	6
27	9
28	1
30	1
32	1

The functional areas not listed here may be covered in existing programs but coverage was not apparent from the program name. Also, for the functional areas identified there may be sections from other programs that provide coverage of them.

activities. There is some repetition of audits performed at similiar activities. Thus, microcomputer audit applications could be developed and shared among audit sites at similiar activities. Also, a number of audits covering the same functional areas are performed at many Navy and Marine Corps activities. For example, audits of civilian personnel and timekeeping are performed at virtually every audit site. Microcomputer audit applications for these functional areas could be reused every time an audit is performed. Other audits of certain functional areas or activities are performed at several locations. Among these are audits of commissary stores, morale, welfare and recreation activites, and Personnel Support Activities. Microcomputer audit applications developed for an audit of one activity should be transportable to audits of similiar activites. However, these audit applications should not be reused without considering any unique conditions that exist at the audited activity. The microcomputer applications should be reviewed in the same manner as audit programs. The audit program steps may require refinement to fit the audited activity. The audit applications may require the same type of refinement to satisfy the objectives of the audit step. However, it is much easier to modify an existing application than it is to create a new one.

Although it will take time to develop microcomputer applications for performing audit data gathering and analysis there is one audit task that benefits immediately from microcomputer use. The use of word processing software to produce written audit material is very beneficial to auditors and audit managers. Audit written material includes audit announcement letters, survey debriefs, findings and the final audit report. These documents have a specified format. The word processing software allows users to design a unique format for individual documents and insert and delete text where needed. The Naval Audit Service could develop a word processing format for these recurring documents and distribute them throughout the organization. Auditors and audit managers would add the necessary text to the document and revise the document as needed. Also, the ability to change portions of the text in an audit finding or report will speed up the editing process and decrease the audit time.

Personnel scheduling and management, time reporting, budgeting, audit planning and performance evaluations are some of the administrative tasks performed by auditors and audit managers. These tasks are characterized by known requirements, standards, reporting formats and known deadlines. All of these factors make it possible for these tasks to be performed using microcomputers. The Naval Audit

Service can develop software applications for performing these tasks using the organization's existing software. Chapter 3 of this thesis contains specific examples of how this software can be used for these administrative tasks.

F. INTRODUCING MICROCOMPUTERS SUCCESSFULLY

1. General Implementation Strategies

Tharrington suggests that the following microcomputer specific methods will ensure successful microcomputer implementation and use in organizations:

- Establish and maintain a large microcomputer software library for organizational use.
- Restrict microcomputer use to small files and small data bases, in relation to mainframe files and data bases. Continue processing large files and performing lengthy calculations on the mainframe computer.
- Establish a microcomputer steering committee. Committee members should come from the user groups, the data processing department, and senior managers. The committee functions to evaluate hardware and software requests, to set priorities for microcomputer use and procurement, and to set microcomputer policies and procedures.
- The organization should name a microcomputer coordinator. The coordinator's purpose is to be a liaison with vendors and hardware repairmen. The coordinator should also be technically, administratively, and procedurally competent to answer user questions.
- Establish microcomputer objectives. But, allow the users to develop what they consider high priority applications with off-the-shelf software.
- Introduce the microcomputer as a sophisticated audit and management tool for everyone. The objective should be that the microcomputer becomes as common a device as an electronic calculator or a typewriter.
- Develop methods to measure cost savings and increased efficiency. Although these are often difficult to measure, they must be measured both to justify the current investment and the continued use of microcomputers, and to justify future procurement of new technology. [Ref. 19]

As with any productivity tool, microcomputers have an expected useful life. Long-term planning for the complete utilization of the microcomputer and its eventual replacement will ensure that the Naval Audit Service obtains the maximum benefits available from the microcomputer on a continuing basis. Formal life-cycle management of microcomputers lends credence to them as items of permanence and strategic value to the Naval Audit Service. The Naval Data Automation Command prescribes formal life-cycle Management for major ADP equipment in SECNAVINST 5231.1b, "Life Cycle Management (LCM) Policy and Approval Requirements for Information System (IS) Projects." Life-cycle management is defined as:

> . . . the process for administering an AIS over its whole life with emphasis on strengthening early decisions which shape AIS costs and utility. These decisions must be based on full consideration of functional, ADP, and telecommunications requirements in order to produce an effective AIS [Ref. 20].

Although life-cycle management is not required for microcomputer systems as it is required for major AIS, developing a strategic plan for managing the microcomputer is a viable method of maintaining the microcomputer as an effective and important audit tool. The Air Force Audit Agency has developed a long-range plan and policy statement for the use of its microcomputers.

2. **Communicating Microcomputer Information to the Organization**

Maintaining a central software library is one method of collecting useful programs. A central software library also gives every user in the organization access to labor-saving software.

In addition to the central software library the Naval Audit Service should consider creating a central library of microcomputer audit applications. This library would contain individual applications (e.g. Lotus spreadsheet templates, dBASE III programs) that were developed and used on an audit or for an administrative task. The library entry could contain a description of the application, software used, audit program step or task used on, identification number of the audit application was used on, and results achieved.

A simplified version of an audit application library system was developed by the authors and two associates using dBASE III Plus. The library system, called *The Naval Audit Service Software Application Data Base*, contains three files.

- Program File - Records in this file contain steps from the Naval Audit Service audit guide programs.
- Application File - Records in this file contain the audit application name, application developer, application description, audit program step used for and software package application used on.
- History File - Records in this file contain the audit identification numbers and the audit application name.

The Naval Audit Service Software Application Data Base program allows the user to add, delete, modify or search for a record from any of the three files. Also, data from separate files can be combined to meet a user specified condition. For example, the user could produce a listing of all software applications developed for a specific audit program. Also, the program allows the user to perform ad hoc queries of the files through use of the dBASE III Plus query program. The various files and capabilities of the program are accessed through a series of menus. This makes the program easy to use and user friendly.

A database application similiar to this would be easy to implement in the Naval Audit Service. Information contained on the data base could be distributed to

auditors in several ways. Print outs of the data base could be incorporated into a microcomputer newsletter. A floppy diskette containing the data base could be distributed to the audit sites periodically. Finally, the data base could be on-line and accessed by auditors through a Naval Audit Service electronic bulletin board.

The Air Force Audit Agency has published "A Microcomputer Applications Guide" to communicate information about microcomputers to its auditors and audit managers. This guide contains a description of the software tools available in the oranization and a series of audit applications available for use during each phase of the audit process. The guide will be updated periodically to reflect new applications.

3. **Newsletters and Electronic Bulletin Boards**

A microcomputer newsletter is another means of distributing information about microcomputers to the audit organization. The newsletter would keep users abreast of changes in the organization's data processing capabilities, new developments in hardware and software, and provide users with new ideas and recommendations for using microcomputers. Material for the newsletter is available from many sources and is often available at no charge. The newsletter should be written in nontechnical terms with a minimum of computer jargon. The newsletter should be published regularly so that it becomes an anticipated part of organizational operations.

Instead of creating a separate newsletter the Naval Audit Service could incorporate microcomputer news into the "Staff Notes of the Auditor General". This publication is produced bi-monthly. The microcomputer news could become a regular feature like the current statistics article "Math Path to Audit Trails". Another option for distributing microcomputer news is through the existing regional newsletters.

Electronic bulletin boards can also be used to enhance the microcomputer's usefulness to the Naval Audit Service and to help ease introduction of the microcomputer into the Naval Audit Service. Electronic bulletin boards can be either an alternative to or in addition to newsletters. The electronic bulletin board's major advantage, when used as an alternative to newsletters, is saving of printing and distribution costs. Electronic bulletin boards also can be used to send and receive electronic mail. The bulletin board could be set up at a central site (headquarters, for example) and used to send and receive news that would normally be printed in a newsletter. The electronic bulletin board, in the reverse, can be used as a receiving station for reports and high-priority mail.

Electronic bulletin boards are software based systems that allow remote users to access a computer at a central site. The bulletin board software provides the organization with a means of sharing information among its employees and allows users at different locations to access and exchange information and ideas. The features of the bulletin board software include password security systems, file-transfer capabilities, networking capability among others.

A final method for communicating microcomputer information to an organization is through use of a support group. The primary mission of such a group is to manage and deliver goods and services related to the application of microcomputer technology. [Ref. 21] The services a support group could offer include:

- Consultation
- Requirements analysis
- Training and product demonstration
- Internal newsletter production
- Information clearinghouse services [Ref. 21]

The Air Force Audit Agency has established a Small Computer Technical Center to help its auditors use microcomputers for performing audit tasks. Many of the services listed above are provided by this organizational component. Currently, the Naval Audit Service relies on regional systems administrators and auditors experienced in using microcomputers to provide these types of services. Development of a microcomputer support group would provide users with one source for microcomputer assistance and guidance.

III. SOFTWARE SURVEY AND AUDIT SERVICE PROCESSES FOR MICROCOMPUTER AUTOMATION

A. INTRODUCTION

This chapter explores the manner in which microcomputer software may be employed to increase the efficiency of Naval Audit Service work. This chapter will also illustrate specific ways in which microcomputer software can increase audit efficiency, and it will suggest which categories of software are appropriate for automating auditing and audit management tasks. Further, this chapter will review selected products from each of the categories presented in this chapter. However, this chapter will not recommend purchases of any particular software by the Naval Audit Service.

This discussion of microcomputer software is arranged by major audit and audit management tasks. Within each category, selected software, useful for accomplishing each task, is presented from three possible sources, i.e., commercial vendors' software, public domain and government developed software. Software was tested with either demonstration versions provided by the software vendor or use of the actual production version of the program. All figures for this chapter can be found in Appendix B.

There are many factors to consider when choosing microcomputer software. This discussion focuses on those features that are most important to the general user. [Ref. 22: p. 30] These features are program capabilities, dialog, ease of use, the program output displays, program commands (and formula development in the case of spreadsheets), the HELP facility, error handling and any unique features. The dialog provides the interface between the user and the machine. The dialog style directly contributes to the user's perception of the value of a particular software package and, resulting from that, the frequency of use and the quantity of tasks accomplished with that software. Sprague and Carlson [Ref. 23: pp. 198-217] identify six styles of dialog in their discussion of decision support systems that are generally applicable to most application-oriented software. These six dialogs are as follows:

- *Question-answer* which presents a series of questions to the user, singly, in plain language. The user's response begets another question from the computer until the computer program is finished (or the user quits). This dialog is successful for inexperienced or infrequent users, whenever they are unfamiliar with the problem at hand
- *Command language*, which uses one word or short phrased commands to initiate some action from the computer (for example the command: PRINT DAILY

REPORT). Command language is useful for experienced users performing repetitive tasks; it speeds up task initiation by permitting the user, who understands the solution to the current problem, to solve the problem by ordering the solution directly, without wasting time answering the computer's questions. The disadvantage of command language is that infrequent users tend to forget the commands and must re-learn them before using the program

- *Menu dialog*, which presents the user with several choices that either lead to another menu or initiate action and response from the computer. The user only needs to select from the menu to proceed, or quit. Menu dialogs are effective for infrequent users who are familiar with the problem, but maybe not the solution
- *Input form/output* form, which displays an input form in a style the user is accustomed to seeing on paper. The user then enters data on the appropriate area within the form and receives output from the computer in the same style. Input form/output form works well in cases where the forms are familiar to the user
- *Input-in-context-of-output*, which presents an output (e.g., a table or a graph or a list) within which the user may fill in or select inputs that will either modify the current output or result in a different output. This type of dialog is effective in decision support systems (DSS) that deal with complicated decision-making processes. The disadvantage in this dialog form is that it requires significant training
- *Combinations of the first five* dialog styles [Ref. 23: p. 202].

These combinations make programs flexible and adaptable to different levels of user skill and training. The popular word processing program WordStar, for example, has three different dialogs. WordStar can be set to be completely menu driven for the beginner. The advanced user can work with command language using a callable help menu displayed by a few keystrokes. The expert WordStar user can eliminate all menus entirely and use command language only. In summary, the correct dialog style contributes to preventing beginners from becoming frustrated with a program command structure that they do not understand and cannot use correctly; and, conversely, the correct dialog style contributes to preventing time-consuming menu displays and question-answer dialogs from hampering speedy task accomplishment by expert users [Ref. 23: p. 202].

B. AUDIT SERVICE PROCESSES TO AUTOMATE

1. Work Papers

a. Introduction to Work Papers

Work papers commonly contain a combination of numerical data in spreadsheet form, text, and tabular data presentations. The Naval Audit Service requires that work papers contain tables of contents, audit reports crossreferenced to supporting work papers, draft findings, checklists, standard audit programs, debriefs, charts, graphs, forms, audit assignment letters, etc. These structured requirements are readily met with the aid of microcomputer software.

Work papers are the primary collection medium for the evidence collected during audits. Work papers support conclusions developed during the audit and the final audit report. Therefore, work papers should be prepared, maintained and handled with great care. The United States General Accounting Office (GAO) "Comprehensive Audit Manual" describes the work papers' main purpose as

- To provide a systematic record of work performed in carrying out an assignment.
- To provide a record of information and evidence obtained and developed in support of the findings, conclusions, and recommendations made on the basis of our work [Ref. 24: p. 19-1].

The Naval Audit Service defines work papers as

> competent, and relevant evidence to support auditors' judgments, conclusions, audit findings, and recommendations in audit reports. Work papers should clearly show the audit objective(s) and scope of work performed. [Ref. 16: para 202.1.a]

b. Methods for Generating Work Papers

Electronic spreadsheet software provides a direct, onscreen capability for producing an electronic version of the traditional columnar work sheet. While all spreadsheet programs allow text entry, one line at a time, a full-screen text editor or word processor is a valuable tool for adding paragraph size (and larger) comments to the work papers. Tabular data can be added to work papers in several different ways. A direct method, using an electronic spreadsheet, is to establish the table as a template within the spreadsheet and then simply enter the data in the appropriate rows and columns. Another method is to collect the data in a database, using either a filing or database program. Then the report writer module in the database software is used to generate a tabular report to add to the work paper.

Storage and efficient retrieval of work papers is necessary to preserve their value, enhance their use and serve as historical records. Traditionally, work papers are stored in their paper form. The work paper indexing methods are limited in their cataloging capability. Also, the hard copy work papers require considerable storage space. Electronic storage of work papers can reduce storage space requirements since several hundred pages of information can be stored on one 5 1/4 inch floppy disk. Electronic indexing can provide a wider range of cataloging possibilities that can, in turn, increase the efficiency of work paper retrievals.

c. Specific Programs For Generating Work Papers

(1) *Electronic Spreadsheets.* Electronic spreadsheet programs are especially suited for use in developing electronic work papers. Standard work paper templates can be developed with electronic spreadsheets. The advantages of templates are:

- 'Programmed' uniformity can be achieved in work paper format. The benefits of programmed uniformity are that a) established guidelines are followed and b) inexperienced personnel make fewer administrative mistakes.
- Prevent inadvertent omission of any required information
- Eliminate productive time wasted on clerical preparation of work paper skeletons
- Makes clerical portions of audits faster and more efficient
- Allows easy modifications and additions of work papers. An example of a work paper template is shown as Figure 3.1 in Appendix B. [Ref. 16: para 202.3.b]

(2) *Work Paper Generators.* Templates can be developed using an electronic spreadsheet program alone or with an add-on program that specifically generates work papers. There are several automated work paper generators available in the commercial marketplace. One such generator, that operates inside of 1-2-3 by Lotus Development Corporation, is focus:ABC by Hemming Morse,Inc., CPAs. Hemming Morse claims that the productivity benefits of focus:ABC are:

- Reduces total engagement time
- Reduces or eliminates paper and pencil entry by automating time-consuming clerical functions
- Because of ABC's link with Lotus 1-2-3, ABC is fast and easy to learn
- Experienced Lotus 1-2-3 users can create custom workpapers from ABC data or modify and add to the ABC worksheets and programs
- System flexibility allows "what if" calculations [Ref. 25]

Focus:ABC is intended for use by public accounting firms and is primarily designed for audits, compilations, reviews, tax returns and ratio analysis.

(3) *Word Processors.* Microcomputers significantly reduce the clerical effort needed to develop and maintain work papers. A word processor, for example, replaces the traditional "cut and paste" method of re-arranging and re-writing information by electronically moving blocks of text within a document and between separate documents. This feature eliminates the need to retype entire documents just to change a few words or paragraphs. For auditors, this translates into labor hour savings when developing and revising tables of contents, draft findings, checklists and other documents. For example, word processors can create and store frequently used

documents. Appendix C of the Naval Audit Service Handbook lists 44 standard audit programs presently in use [Ref. 16: App C]. Storing these audit programs as word processed documents can help reduce printing costs. Rather than printing multiple copies for routine distribution, audit programs may be distributed on floppy disks and printed whenever needed. This assumes that the Naval Audit Service uses the same (or compatible) word processors at all of its offices.

With regard to work paper storage, the GAO recommends that all work papers be indexed and cross-referenced:

> The master index should show the storage device and location of each storage device and location of each workpaper. It should also provide information on the subject of the worksheet, its title and the type of file it is; e.g., a LOTUS spreadsheet. It is also very useful to have an abstract of the content of important workpapers and to develop key words to associate with each. . . . [Ref. 15: p. 27].

Efficient recovery of electronically stored work papers requires electronic cataloging. DISKCAT is a public domain cataloging program that is powerful, yet easy to use. According to the program documentation, DISKCAT

> . . . file names, date and size to a catalog file, gives a disk its own table-of-contents file, prints a file listing to keep with each disk, deletes a disk from the catalog file, displays names of all disks in the catalog along with number of sectors and sides and free space remaining on each disk . . . add file category and description, rename files/disk, delete file, view file contents, locate file/disk in catalog . . . . sorts, prints the catalog file; it will compare two catalog files and print a comparative list showing differences and matching files . . . . creates data file in a format that can be read by Lotus 1-2-3. All or part of a catalog can be sorted by file name, disk name, file type, date or file extension . . . . search the catalog for a specific file to find which disk it is on . . . [Ref. 26: p. 1]

Figure 3.2 is a sample of the output from DISKCAT for an imaginary set of work papers stored on floppy disk. DISKCAT reads the floppy disk, itself. This ensures that no file on the diskette will be missed.

2. Spreadsheets and Analysis

a. Introduction to Spreadsheets and Analysis

Spreadsheet programs provide electronic versions of the accountant's columnar pad. "Virtually any audit task for which pencil, paper, and a calculator are required can be done on an electronic spreadsheet package." [Ref. 27: p. 4] The usefulness of electronic spreadsheet programs lies in their ability to quickly and accurately calculate formulas after numbers are entered into the rows and columns

[Ref. 28: pp. 777-786]. The result is an instant display of the effect of different data on the outcome of the analysis. "What-if" analysis can consider all possibilities within minutes. This increases auditor productivity by reducing manual duplication of data into different spreadsheets. The spreadsheets can be saved, retrieved and re-used an indefinite number of times. This makes them valuable, time-saving tools for frequent tasks. All spreadsheet programs perform the basic mathematical functions of addition, subtraction, multiplication and division. The more advanced spreadsheets have library functions such as summations, averages, record counts, logarithms, roots, powers, statistical analysis, regression analysis and currency formatting. Also, editing commands are included for revising the spreadsheet format. The most advanced spreadsheet programs on the market can import files created by database and word processing programs and have graphics routines to enable graphic display of the data. [Ref. 29: pp. 76-77]

b. Audit Procedures Using Spreadsheet Analysis

Numerical analysis is officially required by Naval Audit Service regulations as financial profiles in section A of "blue cover" audit reports [Ref. 16: para 610-7a.3.a]. In addition to financial profiles, virtually all exhibits summarizing numerical data lend themselves to spreadsheet formats. These include operations summaries [Ref. 16: App JJ], disbursing reviews, welfare and recreation fund analysis, inventory analysis, travel expense summaries, efficiency audits, trend analysis, and sensitivity analysis. Figure 3.3 is the electronic spreadsheet version of the financial profile shown in the Naval Audit Service handbook [Ref. 16: App II]. The auditor simply inserts the descriptive titles and amounts onto the template spreadsheet and in seconds obtains a correctly calculated profile. The original template is preserved by re-naming the finished profile before saving it to disk. The template is re-usable and saves time in preparing the financial profile and computing totals. The same display is shown for the operations summary from the Naval Audit Service handbook, App JJ in Figure 3.4. A template for summarizing cash counts during a disbursing office audit is shown in Figure 3.5. The Disbursing Officer's cash management performance can be measured objectively with the aid of an electronic spreadsheet. For example, the spreadsheet may be used to compute cash requirements for the past year and then compare actual cash on-hand against the computed requirements. Any significant deficiency or excess cash-on-hand compared to the required amount will be immediately obvious in the dollar and percentage differences.

c. Specific Programs

(1) *1-2-3.* 1-2-3 by Lotus Development Corporation is an extremely powerful commercial spreadsheet program that GAO has adopted as the standard GAO spreadsheet package. 1-2-3 is widely used in the commercial sector and it is also part of the Naval Audit Service software library. The reliability of 1-2-3 is such that GAO technical guidance allows that:

> When the standard GAO spreadsheet package, LOTUS 1-2-3, is used documentation of the program itself is not required. However, ... as for a manually prepared spreadsheet, the user should clearly indicate what information is contained in each row and column of the spreadsheet, specify the source of the information, identify calculations performed, and list all formulas used for automatic calculation.
>
> Much of the information required for good spreadsheet documentation can be entered directly onto the spreadsheet itself. Separate sections of the spreadsheet can be used to list data sources, describe the variables included, detail the assumptions of the analysis and describe models embedded in the spreadsheet. Separate sections can be devoted to information on the preparer, the date, the version of the spreadsheet and on other facets of file management . . . . LOTUS permits the user to list out formulas for each cell . . . [Ref. 15: p. 29]

1-2-3 v2.0 has the following spreadsheet capabilities:

- 8192 rows by 256 columns
- Functions: Time, Financial, Statistical, Mathematical, Logical and Special
- Windows-horizontal or vertical
- Titles-horizontal and/or vertical
- Printout control-formatted headers and footers, borders, margins, printer setup, page length (20-100), automatic page numbering, and date insertion, single or continuous feed, print to file and print text of formulas

The items in the 1-2-3 menu are selected using the arrow keys. Alternately, 1-2-3 commands are available through single keystrokes for the experienced user. 1-2-3 is very easy to use. The names of the menu choices describe their functions so that they seem logical to the user who is not a computer expert. The menu, error message and border areas of the display take up only four lines at the top, one line at the bottom and one column on the left side of the screen, leaving the rest of the display area for entering data onto the worksheet. This results in a highly readable display and minimum delay when scrolling to portions of the worksheet that lie beyond the current displayed portion. The blank worksheet area is uncluttered, except for the date and time displayed on the left corner of the last line. Formulas for automatic calculation can be developed using several methods. One method is simply

to type the cell references and operators into the receiving cell. A second method is to begin in the receiving cell and move the cursor into each referent cell inserting the mathematical operator or function name into the formula. Cell references within a formula may be absolute, relative or a combination of absolute and relative. Absolute cell references allow use of the values of a fixed location cell in a calculation. Whereas a relative cell reference permits the location of the referenced cell to change as calculations progress through a series of data entries.

1-2-3 has an extensive HELP facility. The HELP resides in a file which is callable at almost any time from the main program by pressing a special function key. Information is provided on these topics:

- Using the help facility
- Errors and messages
- Using the help facility
- Error message index
- Special keys
- Control panel
- Modes and indicators
- Formulas
- @Functions
- Cell formats
- Operators
- Ranges
- Pointing to ranges
- Reentering ranges
- Starting over
- Ending
- Moving the cell pointer
- Cell entries
- Commands
- Command menus
- Column widths
- Macros
- Function keys
- Menus for file, range, and graph names
- File names

Help information is displayed one screen at a time. More help menu selections are displayed on the lower portion of the screen for information about program functions which are associated with the current help display. Program execution returns to the exact point where the HELP facility was invoked. The help screens are written using non-technical language. They are not a substitute for the reference manual, but a person who is familiar with the operation of electronic spreadsheets, in general, should be able to use all but the most advanced functions with only the help screens. Many programs leave much to be desired in the area of error messages. 1-2-3 handles errors with detailed explanations, but without computer jargon.

A special feature of 1-2-3 that gives 1-2-3 powerful processing capabilities is the MACRO. Any sequence of keystrokes that can be typed on the keyboard can be written down in an unused area of the worksheet for automatic execution by 1-2-3. Macros are capable of executing all of the commands that are available to the user. Macros can automatically set up a template, execute repetitive commands, prompt the user, display menus, check data and spreadsheets for error conditions, run consolidations of spreadsheets into one master spreadsheet, build databases and tables, and other functions.

1-2-3 macros are powerful. But, they are tedious to create, and time-consuming to debug. DataSource Publishing Company markets a program called AutoMac which automates 1-2-3 Macro writing. It is designed to run within 1-2-3 and save keystrokes as the user enters keyboard commands.

The Spreadsheet Auditor by Consumers Software, Inc. is a utility developed for 1-2-3 that checks formulas and cell references within a 1-2-3 worksheet for inconsistencies such as circular references and formula redundancies. It also provides the capability to assign descriptive "pop-up" notes to any individual cell in the worksheet.

(2) *MultiPlan.* MultiPlan by Microsoft, Inc. is another powerful spreadsheet program. The spreadsheet capacity is 255 rows by 63 columns, but maximum column width is limited to 32 characters. MultiPlan utilizes standard day-month-year time functions and standard boolean logic functions. Unlike 1-2-3, MultiPlan does not support string manipulation functions, unique table lookup functions, or extended cell pointer functions. However, MultiPlan uses fewer keystrokes to select menu items than 1-2-3. Multiple window commands, in color, allow the user to view different areas of a large worksheet on the screen simultaneously. The

ascending or descending, multiple-key sort function is easy to use and fast. MultiPlan has linked spreadsheets; 1-2-3 does not. Entering data in one spreadsheet causes all spreadsheets linked to the on-screen spreadsheet to be automatically updated. This eliminates the possibility of incomplete file updates due to operator omission. MultiPlan graphics are primitive. Numbers are represented graphically by displaying asterisks across a row within the worksheet as a histogram.

The dialog in MultiPlan is menu based. Items are selected by pressing the space bar and [RETURN] key or the first letter of the menu item. As in 1-2-3, sub-menus appear where further choices are available. The dialog is simple, easy to use and effective.

The screen display is similar to 1-2-3, except that the menu is located at the bottom of the screen along with the prompt and data entry line. The work area occupies the rest of the display area on the screen; it is uncluttered and highly readable. The commands are logical and contribute to the ease of using MultiPlan, with one exception. The program does not automatically reset from alphabetic or numeric mode after data entry. Resetting the data type becomes tedious when entering large amounts of mixed data types.

Formulas are developed by typing in cell coordinates, pointing to the cell to be included or using the cell name directly in the formula. This last option increases the readability and understandability of the formulas in the worksheet. Also, maintenance effort for a template whose formulas are written in plain language is significantly reduced. For example, where other spreadsheets require a formula such as "+B2-C2", MultiPlan allows "Net Income = Gross Income - Total Expenses" as a valid formula (assuming these are also valid cell names). 1-2-3 does not support this capability.

MultiPlan's HELP facility is not as extensive as that of 1-2-3. But, it is useful as a quick reference for experienced users. Error handling in MultiPlan is simple. However, although the short phrase error messages are readable they do not adequately describe the problem. MultiPlan will not allow illegal formulas to be entered into a cell. But illogical formulas are acceptable and will compute erroneous results for the unsuspecting user. However, this is also true for 1-2-3.

(3) *CalcStar.* CalcStar by MicroPro, Inc. is an electronic spreadsheet program patterned after VisiCalc, the first widely used spreadsheet. The worksheet capacity is 255 rows by 127 columns. CalcStar's calculator functions are simple

addition, subtraction, multiplication, division, and exponentiation, with system functions limited to:

- SUM Sum values
- CNT Count values
- AVG Average values
- MAX Maximum value
- MIN Minimum value
- SQRT Square root
- LOG Logarithm
- LN Natural logarithm
- ABS Absolute value
- EXP Exponent
- REGR Regression
- PROJ Projection
- DEPD Dependent variable for REGR
- SLOPE Slope of REGR

Logical operators are <, >, =, <>, <=, >=, AND, and OR. The on-screen dialog is divided into three sections which are top, middle, and bottom of the screen. The menu of commands takes-up the first five rows of the display area. The first letter of each command is displayed twice to emphasize the input selection. Highlighting the first letter within the command would have provided the intended emphasis and saved space along the row.

CalcStar is simple to use, but moving around within the worksheet area is awkward. The cursor is moved using the control key and another key, depending on the desired direction of movement. Readability is good, but the work area is small due to the large amount of space reserved for the dialog and the menu. The display area is limited to 10 rows, extendable to 15 rows. However, the menu disappears when the display area extends.

CalcStar commands are limited in variety, but easy to use. However, only a single command may reside in memory at any one time. A command not in memory must be read into memory from the disk file prior to execution, replacing the current command. This disk access slows down task accomplishment.

Formula development is straight forward but requires care in specifying cell addresses since CalcStar does not support pointing the cell pointer at the desired cell or range of cells during formula development.

The on-line HELP facility, like CalcStar itself, is straightforward and simple. CalcStar handles errors by displaying a short (3 to 6 words) error message in the display area at the bottom of the screen. The error messages are plain but not very informative. Even with the user manual, the real cause of the error condition is sometimes difficult to determine.

CalcStar has several special features that enhance the basic spreadsheet. First is the CTRL-Z command that sends the cursor to the first column of the next row from *anywhere* in the worksheet. Second, the form control mode allows the programmer to specify a sequence of cursor moves to be executed automatically during data entry in a template. Third, CalcStar can print output to a disk file in text format for later printing or importing to a word processor. Finally, a utility provided with CalcStar (CSDUMP.COM) will print the formulas and specifications contained in each cell of the spreadsheet.

(4) *Encore!*. Encore!, by Ferox Microsystems, Inc., is a mainframe quality financial modeling program for microcomputers. It is closer in form and purpose to a decision support system generator. As such, it is more flexible than a spreadsheet program for developing financial models and specific output formats for those models. Whereas electronic spreadsheet programs present the user a blank worksheet to fill-in with formulas and other commands for individual cells, financial modeling programs allow the user to develop formulas in an English-like manner, unrestricted by cell boundaries.

According to the literature provided by Ferox Microsystems, Encore! has the following features:

- Separation of logic, reporting, and data; this allows repetitive use of logic and report files with an unlimited number of different data files.
- English-like modeling language
- Following modeling commands:
  - Arithmetic operators
  - Column specifiers (FOR, COLumn)
  - ABSolute value, MINimum, MAXimum, EXPonent, LN,
  - LOGarithm, POWER
  - LEAD, LAG, SPREAD for shifting numbers
  - Table lookup
  - Indirect addressing
  - INCLUDE for linking logic files

  - Boolean operators
  - Conditional logic (IF-THEN-ELSE)
  - Financial function library
  - Day/Date functions
  - Looping
  - Others
- Goal Seeking; allows determining what the required parameters must be in order to reach a specified goal.
- Full screen text editor
- Matrix manipulation and arithmetic
- ASCII files can be interpreted as data
- Read and write Lotus 1-2-3 worksheet files
- Customized report generator
- Presentation quality graphics with a graphics editor
- Menus and on-screen prompting; allows inexperienced users to enter data and generate reports after a model is developed.
- Monte Carlo simulation

A copy of Encore! was not available for testing. Therefore, it cannot be evaluated in terms of ease of use, screen displays, HELP facility and error handling solely on the claims of Ferox Microsystems. However, Figure 3.6 provides the record of a session using Intermediate Financial Planning System (IFPS), which is a mainframe financial planning program with features closely resembling those of Encore!.

The main advantage in using a financial planning program rather than an electronic spreadsheet lies in analyzing large amounts of data in complicated models. The financial planning program, unlike the spreadsheet, is only limited by the memory capacity of the computer's hardware, not the worksheet area provided by the electronic spreadsheet. Table 3 provides a subjective comparison of the spreadsheet programs presented above.

TABLE 3

SUMMARY OF COMPARISON OF SREADSHEETS

	1-2-3	MultiPlan	CalcStar	Encore!
Cost	$450	$350	$125	$475
HELP Facility Usefulness	Outstanding	Good	Good	Unknown
Ease of Use	Outstanding	Excellent	Good	Unknown
Power/Sophistication of Available Algorithms	Outstanding	Excellent	Good	Unknown
Speed	Excellent	Excellent	Very Good	Unknown
Efficient Memory Use	Excellent	Excellent	Excellent	Unknown

Note: Scale from - Outstanding
Excellent
Very Good
Good
Poor
Unknown (if software was not tested)

3. Statistical Sampling

a. Introduction

Statistical sampling is a commonly used auditing technique. "Statistical sampling is a tool which permits the auditor to determine sample reliability and the risk of his accepting it [Ref. 30: p. 238]." Meigs, Larsen and Meigs define five phases of statistical sampling

- Define the objectives and nature of the test
- Determine the method of sampling to be used
- Calculate the sample size
- Select the sample
- Interpret the sample results [Ref. 30: p. 239]

Microcomputers can assist auditors with the last three phases. The advantage in using a statistical sampling program is that the software overcomes the limitation of published random number tables and eliminates extensive manual calculations.

b. Methods for Microcomputer-Based Statistical Sampling in Auditing

Microcomputer software can be used to generate random numbers, and prepare interval, stratified, or cluster samples. Specific statistics can be calculated such as mean, median, mode, standard deviation, and required sample size. The more sophisticated programs also perform multiple linear and non-linear regression, one and two way analysis of variance, significance testing, and correlations of data [Ref. 31: p. 5]. Further, some programs calculate projected error based on the audit sample results, permitting computation of an allowance for sampling risk. "The upper limit of the possible deviation rate (compliance tests) or the upper error limit (substantive tests) can be automatically calculated, and amounts can be recalculated at varying levels of sampling risk" [Ref. 27: p. 27]. However, the AICPA also warns that

> . . . caution must be exercised when acquiring sampling software; there is a variety of sampling methods and formulas - only some of which are appropriate to audit applications. Certain software produces results in terms of a lower error limit when the auditor desires (and may believe he or she has computed) an upper limit. In addition to ascertaining whether the methods and formulas employed in a program are appropriate, the auditor should determine whether the software provides for the large number of digits (that is, for dollar amounts) as well as for the stratum and population sizes that are common to financial audit applications but not to most other areas in which sampling is used. [Ref. 27: pp. 27-28]

c. Specific Programs

(1) *MICROSTAT.* MICROSTAT by Ecostat, Inc. is the statistical package currently in use by the Naval Audit Service. Its main menu, showing the program capabilities, is shown in Figure 3.7.

The dialog uses a combination of user-friendly menus and question-answer prompts. The software is so easy to use that anyone with a basic understanding of statistics should be able to use MICROSTAT without the program documentation. The only minor irritant is the inability to return to the main menu from any point in the program. There are several places where returning to the main menu is possible only by rebooting the computer. Two major shortcomings with MICROSTAT are the absence of a random number generator and the absence of a routine to calculate sample size. A HELP facility is not available, but it is not needed due to the clarity of the menus and prompts. Errors are handled on-screen, interactively, with easily understood error messages.

A special feature of MICROSTAT is a module that generates a table of probability distributions for eight different kinds of probabilities--binomial, hypergeometric, poisson, exponential, normal, F-distribution, student's t, and chi-square. This allows the auditor to take advantage of a range of capabilities in audit sampling.

(2) *EPISTAT.* EPISTAT is a set of statistical programs, in the public domain. Figure 3.8 is a printout of the program modules. EPISTAT has both a random sample generator and a sample size calculation routine. The EPISTAT dialog is a combination of menus and interactive question/answer. The display is natural and highly readable, on a color monitor. The readability is severely degraded on a monochrome monitor, however, due to the fact that the program is written for color.

Error handling capabilities of the various modules are only fair. For example, choosing a numbered selection greater than the highest number or lower than the lowest number on a menu re-displays the prompt. But the program does not check for input of a letter. Instead the program defers to the BASIC language interpreter to trap the input type mismatch. The same is true for input of any alphabetic character whenever numeric data is expected. Additionally, the modules ungracefully allow the BASIC interpreter to crash the program on input of large numbers that overflow the computer's arithmetic registers. Its inadequacies not withstanding however, EPISTAT is a useful package.

(3) *1-2-3.* As part of the spreadsheet modeling capability, 1-2-3 by Lotus Development can also be used for statistical sampling and analysis. 1-2-3 (v2) has a multiple regression function in addition to the statistical functions in prior versions. Figure 3.9 is a 1-2-3 template that selects a random dollar-unit sample from a Poisson-probability distribution. The template in Figure 3.10 calculates the upper confidence bound for the mean sample error for the dollar unit sample computed in Figure 3.9 Both templates were developed by Willits and McCoslin for use with 1-2-3 version 1A, however they will run on version 2.0. These templates were developed for use in the "combined-attributes-and-variables (CAV)" sampling technique. An in-depth discussion of dollar-unit-sampling is not provided in this thesis since the objective is to identify microcomputer tools for auditors rather than discuss principles. For an in-depth discussion see Willits and McCoslin.[2] [Ref. 32: pp. 62-69]

---

[2]It was necessary to modify the Willits and McCoslin macro in cells K18 through K20 to correct a run-time sort error in the spreadsheet. The formulas and calculations developed by Willits and McCoslin were not changed.

The 1-2-3 regression module is flexible and extremely useful. In the example in the previous paragraph, it is used to project expected inventory validity as a function of the dollar value of inventory and the number of different stock numbered items held in storage. Figure 3.11 shows the historical data and the regression output. Figure 3.12 depicts the data graphically. Audit teams using this type of analysis could spot unusual trends immediately, and could adjust their audit procedures accordingly. [Ref. 33: pp. 106-110]

(4) *STATPLAN.* STATPLAN by The Futures Group, Inc. is a statistical analysis program designed for use by non-statisticians. STATPLAN is capable of performing the following analysis:

- Basic statistics
- Correlation analysis
- Analysis of variance (ANOVA)
- Multiple regression analysis
- Auto correlation analysis (analysis of seasonality and cycles)
- Curve fitting
- Exponential smoothing
- Cross tabulation

Basic statistics includes the number of data points, number of valid data points, lowest value, highest value, range, mean, standard deviation, coefficient of variation, skewness, kurtosis and median. In addition, cross tabulation outputs the chi-square statistic, phi, Cramer's V and the contingency coefficient.

The STATPLAN dialog is menu driven and provides several capabilities in addition to the analysis capabilities listed above. A portion of the main menu is reproduced below:

1. ENTER new data from the keyboard
2. READ data from disk file
3. SAVE data now in memory to disk
4. TRANSLATE data files to or from STATPLAN format
5. EDIT data now in memory
6. TRANSFORM data now in memory
7. CREATE new data series from mathematical functions
8. DISPLAY data in tabular or graphical form
9. ANALYZE data

STATPLAN can read data files and output from other programs. Also, it can output data into ASCII files for export to any program that can read ASCII files (e.g., WordStar, MultiMate, 1-2-3, dBASEIII, etc.). Data entry from the keyboard is performed within the STATPLAN full-screen editor. A working copy of STATPLAN was not available for testing and, therefore no comment is made on the program's ease of use or other features. Table 4 provides a subjective comparison of the statistical programs presented above.

TABLE 4
SUMMARY OF COMPARISON OF STATISTICAL PROGRAMS

	MICROSTAT	EPISTAT	1-2-3	STATPLAN
Cost	$150	$35	$450	$99
HELP Facility Usefulness	N/A	N/A	Outstanding	UnKnown
Ease of Use	Outstanding	Excellent	Excellent	UnKnown
Power/Sophistication of Available Algorithms	Outstanding	Excellent	Outstanding	UnKnown
Speed	Excellent	Good	Excellent	UnKnown
Efficient Memory Use	Excellent	Very Good	Excellent	UnKnown

Note: Scale from - Outstanding
Excellent
Very Good
Good
Poor
Unknown (if software was not tested)

4. **Report Generation**

a. Introduction

This section discusses microcomputer report transmission methods, automated report consolidations, software designed to improve written communications, and graphical report presentation techniques.

b. Methods

Naval Audit Service regulations stipulate that, "At the same time an audit report is released to the printer, the regional office will telecommunicate it to NAVAUDSVCHQ (AUD-3) . . ." [Ref. 16: para 613-10]. The traditional telecommunication technique is page-at-a-time telecopy using facsimile transmission over the telephone network. This is extremely slow and subject to telephone line interference which could result in garbled data. Microcomputer to microcomputer data transmission is faster than telecopy. In addition, microcomputer transmission methods allow for receipt confirmation and re-transmission of un-acknowledged data.

Consolidating periodic reports into master profiles can be labor intensive and time-consuming, especially where tabulations and statistics are involved. Spreadsheet and word processing software is useful for consolidating standardized, reports such as labor hour reports and submitting information for Staff Notes of the Auditor General [Ref. 34: para 5019].

Graphics can increase readability and understandability of written reports. Several programs for the microcomputer that produce professional looking charts and presentation quality graphs will be discussed.

c. Specific Application Programs

(1) *Smartcom.* Smartcom, by Hayes Microcomputer Products Inc., is the de facto standard by which the microcomputer industry measures the capabilities of MS-DOS-compatible, telecommunication software. Hayes developed Smartcom as the companion to its original, programmable modem, called Smartmodem.

Smartcom is a menu-driven interface between the user and the modem. The user commands the modem through the Smartcom software by choosing from the Smartcom menu rather than through primitive, modem-level commands. In addition, Smartcom has a programmable dialing directory. This dialing directory holds user-entered telephone numbers and transmission parameters that allow error-free, repetitive calling from the dialing menu, after the user correctly establishes the initial dialing entry. In addition to originating a call, Smartcom is capable of automatically answering at the same speed as the incoming call, up to 9600 baud. Smartcom also provides ASCII file-transfer protocol, and Xmodem protocol with error checking for missing sequences of data.

The 10-item main menu is simple but effective. Each main menu selection takes the user to a sub-menu. The submenus are effective but not as simple as the main menu. A new user of Smartcom would have to consult the user manual prior

to setting up initial parameters and using the dialing directory. However, once a data transmision is in progress, Smartcom takes complete control. It uses a status bar in the lower portion of the screen to display the status as the data transfer progresses.

The on-line HELP facility is limited. It cannot be accessed while the software is in control of the data transfer. However, the documentation in the user manual is sensibly arranged and adequately covers every function that Hayes designed Smartcom to perform.

Smartcom recognizes errors from the user, from the modem, and from the telephone line. It alerts the user to each of these with on-screen error messages and sound, if the sound is toggled on. Depending on the nature of the error, Smartcom either attempts to recover and retry or returns to a default menu.

(2) *QModem.* QModem, written by The Forbin Project and placed in the public domain, is another telecommunications program. QModem performs the same basic functions for the user that Smartcom performs. According to the user's manual, "QModem can store phone numbers in a personal directory for later recall. It will handle a variety of modems connected to the PC. Transfer files to other computers, both micro and mainframe, using . . . XMODEM protocols . . ." [Ref. 35] Additionally, QModem allows the user to employ the Xmodem protocol with or without error checking. QModem will operate at any transmission rate up to 9600 baud.

The main menu and the HELP menu are contained in one screen. Qmodem has twenty-eight single or 2-keystroke commands that accomplish the same functions as Smartcom's extensive menu system. QModem also allows manual or automatic dialing and use of Hayes Smartmodem commands when using a Hayes-compatible modem.

Naval Audit Service management is concerned with the length of time required to transmit data during microcomputer to microcomputer data transfers. Figure 3.13 and Figure 3.14 present the results of a test conducted of actual data transfers between two microcomputers. These transfers were performed in the laboratory under ideal transmission conditions, using a dedicated telephone line. Two IBM-PC's, both running QModem, and Hayes compatible modems operating at 1200 baud were used. The storage media were 5 1/4 inch floppy diskettes. Stated in non-technical terms, the size of a single page word processed document is approximately 2,000 bytes; a 1-2-3 spreadsheet, 10 columns by 20 rows, is approximately 1,700 bytes.

Thus, transmission time per page is between 20 and 25 seconds. Or, a 30 page document can be transmitted in approximately 12 minutes. Microcomputer transmission at 1200 baud is approximately 25 times faster than facsimile transmission which requires about ten minutes per page. Table 5 provides a subjective comparison of the telecommunication programs presented above.

TABLE 5

SUMMARY OF COMPARISON OF TELECOMMUNICATION PROGRAMS

	Smartcom	QModem
Cost	$100	$20
HELP Facility Usefulness	Poor	Very Good
Ease of Use	Excellent	Outstanding
Power/Sophistication of Available Algorithms	Outstanding	Excellent
Speed	Very Good	Excellent
Efficient Memory Use	Very Good	Excellent

Note: Scale from - Outstanding
Excellent
Very Good
Good
Poor
Unknown (if software was not tested)

(3) *Telecommunications and the Federal Data Encryption Standard (DES).* Although computer security was specifically excluded from the scope of this thesis, a brief discussion of the security of the data itself, during transmission, is appropriate following the above discussion of microcomputer telecommunications.

While classified information should not be entered into a microcomputer unless the microcomputer is tempest certified, information subject to controls under the Privacy Act of 1974, and not classified, may be manipulated on a microcomputer that has not been tempest certified. It may also be sent over telecommunication lines. This information can be safeguarded adequately by

controlled access and other means while it is in the microcomputer's memory or on a storage device. However, any information, once transmitted over a telephone line, is subject to deliberate eavesdropping and spurious emanation from the transmission medium. Such eavesdropping and emanations can be outside the control of the sender or receiver.

Several programs exist that encrypt unclassified but sensitive data for storage and transmission using the DES developed by the U.S. Department of Commerce, National Bureau of Standards. It is noted here that, although the DES algorithm is efficient and effective when combined with password entry, the DES implemented in software is prohibited for use by Federal Government agencies. Agencies must implement DES in hardware, i.e., through a special microchip. [Refs. 36,37,38: all, p. 2, all]

(4) *Automated Report Consolidation Using 1-2-3.* Spreadsheet software can be used to automate the consolidation process for recurring reports. For example, a master template was developed with 1-2-3 version 2.0. for labor hour reporting. This master template, which was based on the Bi-Weekly Time Report (NAVAUDSVC Form 5220.1), can be completed for each auditor. Then another master template, which was also developed with 1-2-3, will combine each individual report, accumulating the direct labor hours into a single master report. If desired, graphs, pie charts and statistical analysis of the data can also be generated from this same report.

Figure 3.15 shows the blank, master template for preparing the individual Bi-Weekly Time Report. This electronic version is basically the same as the paper version of the Bi-Weekly Time Report. The person who is completing the report simply enters the appropriate information under each column heading and saves the completed report to disk. 1-2-3 performs all the required calculations. Further, the global protection feature of 1-2-3 is selectively enabled, thereby preventing the user from entering data in cells which are not designed for user-entered data. Figure 3.16, Figure 3.17, and Figure 3.18 are examples of completed individual Bi-Weekly Time Reports which will be consolidated later.

Consolidating information from individual reports is tedious, repetitive, and labor intensive. However, the macro facility in 1-2-3 was used in the second template to automate the consolidation task for direct hours. The macro and the blank consolidated report are shown in Figure 3.19. To consolidate individual Bi-Weekly Time Reports with this macro, first copy all the individual report files onto one disk, if

possible. Next after intitiating the macro worksheet onto the screen, invoke the macro by typing ALT-B. The macro will read data from the file into a scratch pad area of the worksheet. Respond to the filename prompt by moving the pointer to the name of the file that contains the individual labor hour report which is to be included in the consolidated report and press the [RETURN] key. This file-input process may be repeated until all individual report files have been included by pressing the Y or N keys, as appropriate, in response to the prompt "ANY MORE FILES TO COMBINE? (Y-N)." After an "N" response the macro sorts the data on the W/M Code field, calculates sub-totals by W/M Code, copies each sub-total line (across the entire two-week reporting period) under the correct report headings, and foots and crossfoots the direct labor hours. Figure 3.20 shows the finished report. It should be noted that this macro uses a large amount of computer memory and 640K of RAM was used to successfully execute this macro. Further, this macro is presented here only as an example of what is possible with microcomputer software. This example could certainly be improved upon, if put into actual use.

(5) *Proofreading.* The Assistant Directors identified proofreading of final draft reports as a top priority for the Audit Service. The traditional method of proofreading requires one person to read a document aloud while another person follows along using a copy of the document being read. This technique is slow and labor intensive. The microcomputer can also be used to proofread the final rough draft and the final smooth copy of a document. The standard operating system software supplied with MS-DOS microcomputers comes with a library of utility programs. One utility, FILECOMP.EXE, is a program that compares two files and outputs a list of differences between the files. Thus, the proofreader can limit his concern to just the differences. The potential labor savings and increased accuracy and timeliness is extemely high using this technique. Figure 3.21 is a file containing an excerpt from Naval Audit Service program number 8, page B-6. Figure 3.22 is the same file with six changes. Figure 3.23 is the output from FILECOMP.EXE with these changes:

- Paragraph 1, line 2--conducting to controlling
- Paragraph 1, line 4--higher authority to headquarters
- Paragraph 2, line 3--";" to "."
- Paragraph 2, line 3--"d" to "D" in determine
- Paragraph 2, line 7--"," after reports is deleted
- Paragraph 2, line 11--Inspection to Inspector

This method of proofreading seems counterproductive with the short example given. However, reducing larger proofreading tasks to this incremental approach will prove very useful. Exercise caution when using this method. There are many versions of this utility program and some will only check for a maximum of ten errors; some will limit the size of the files compared. There could be other limitations, depending on the version of FILECOMP. Also, the utility has other names, such as FC.EXE, and COMP.EXE.

In addition to file comparisons, spell-checking and syntax-checking software is available to provide additional automation of the proofreading process.

(6) *Report Graphics.* Graphics can be a useful addition to audit findings and reports. Significant financial trends and complex relationships can be understood easier using graphics. There are many graphics programs, with different capabilities, available for the microcomputer. Several of these programs allow "free-hand" drawing, make flowcharts and develop complex charts using combinations of graph types superimposed onto one presentation. And others produce just simple XY graphs and scatterplots. Chart by Microsoft, Inc. is a sophisticated program that produces eight different types of graphs and charts. It can superimpose several graphs of similar and dissimilar types in several different colors on the screen. Chart will accept input data from the keyboard or from disk files in Chart format. It can also read disk files created by spreadsheet and data base programs such as 1-2-3 and dBASE. The program dialog is menu-driven through the keyboard or through a mouse. It is very user-friendly and very easy to use. Demonstration graphs (provided by Microsoft, Inc.) are shown in Figure 3.24.

Lotus 1-2-3 graphics are more than adequate for presenting numerical data in pictorial format. 1-2-3 can also read data from other spreadsheets, databases and ASCII text files. This thesis has previously discussed the features of 1-2-3 at length.

PC-Graph, by Softek and available in the public domain, is a reliable program that produces only line graphs. But these line graphs have sharply detailed inter-point connections. First time use of PC-Graph is confusing without the users manual. However, one convenient feature of PC-Graph is that labels and text may be placed anywhere on the display area. Figure 3.25 shows two graphs created with PC-Graph.

5. **Internal Control**

a. Introduction

The current public accounting definition of a system of internal control resulted from a 1948 report by the Committee on Auditing Procedure of the American Institute of CPAs (AICPA), and states:

> Internal control comprises the plan of organization and all of the coordinate methods and measures adopted within a business to safeguard its assets, check the accuracy and reliability of its accounting data, promote operational efficiency, and encourage adherence to prescribed managerial policies. This definition possibly is broader than the meaning sometimes attributed to the term. It recognizes that a "system" of internal control extends beyond those matters which relate directly to the functions of the accounting and financial departments. [Ref. 39]

The AICPA Statement on Auditing Procedure No. 29 further subdivided internal control into two types of controls:

> Internal control, in the broad sense includes . . . controls which may be characterized as either accounting or administrative as follows:
>
> a. Accounting controls comprise the plan of organization and all methods and procedures that are concerned mainly with, and relate directly to, the safeguarding of assets and the reliability of the financial records. They generally include such controls as the systems of authorization and approval, separation of duties concerned with record keeping and accounting reports from those concerned with operations or asset custody, physical controls over assets, and internal auditing.
>
> b. Administrative controls comprise the plan of organization and all methods and procedures that are concerned mainly with operational efficiency and adherence to managerial policies and usually relate only indirectly to the financial records. They generally include such controls as statistical analyses, time and motion studies, performance reports, employee training programs, and quality controls. [Ref. 39]

The AICPA professional standards for evaluating internal control systems stress evaluation of the system from the viewpoint of the independent auditor and the impact of the auditor's reliance on the internal control system as a basis for determining the extent of audit testing. Audit testing will ultimately provide evidence for the audit report. This internal approach, however, could fail to consider external forces (primarily civil laws and government regulations) which might affect an organization's operations. Also, this approach might not completely exploit the latent potential for improved inputs to the management decision-making process as that process derives benefits from the organizational accounting system.

b. Methods

The Department of the Navy addressed this issue in a recent staff study of internal control systems within the Navy:

> The conventional approach to internal control review has far too frequently "fallen short" in a number of significant areas. Based upon an artificial distinction between accounting and administrative controls, and largely ignoring external controls, the traditional reviews have often failed to see the "total picture." This problem has been further compounded by the fact that conventional reviews are frequently limited to one or more segments of a system (manual or automated) rather than the entire system itself. As a result, recommendations to add, delete, or modify system controls have sometimes failed to consider the risk reduction impact of interacting controls operating within the segments not reviewed, as well as external controls existing outside the formal organizational boundaries . . . . [Ref. 40: p. 6]
>
> Lastly, the traditional or convential (sic) approach has not allowed for a ready, "accross-the-board" cost-benefit analysis of the merit of specific controls. For example, control A might not be considered cost beneficial because it only acts upon one or two minor threats within a particular system segment being reviewed. However, the same control might have material impact within the segments not reviewed. Without considering control A in terms of its total risk reduction capacity, incorrect conclusions and resulting recommendations can and have been reached. [Ref. 40: p. 7]

The impetus for the above study came from a series of laws and federal agency pronouncements designed to reinforce internal controls across the federal government. Among them were:

- The Federal Managers' Financial Integrity Act, P.L. 97-255 which amended section 113 of the Accounting and Auditing Act of 1950, 31 U.S.C. 66a. This law required federal agency heads to report annually to the President and the Congress on the effectiveness and compliance of their internal control systems.
- OMB Circular A-123, "Internal Control Systems" revised August 1983, prescribes policies and standards to be followed by departments and agencies in establishing, maintaining, evaluating, improving and reporting on internal controls in their program and administrative activities.
- OMB "Guidelines for the Evaluation and Improvement of and Reporting on Internal control Systems in the Federal Government", issued in December 1982, prescribed guidelines for annual executive agency evaluations of their systems of internal accounting and administrative control.
- Comptroller General "Standards for Internal Controls in the Federal Government" issued in 1983.
- DoD Internal Control Directive, issued March 1982. [Ref. 40: p. 4]

c. Specific Software

The Navy Accounting and Finance Center initiated development of a microcomputer program, written in dBASE III, that would address the shortcomings of the present methods of evaluating internal control systems in the Navy. This program is called Internal Control Information System (ICIS). A synopsis of ICIS follows:

ICIS reviews typically address entire systems rather than individual segments, and provide well documented and readily defensible answers as to the adequacy and cost-effectiveness of both individual and overall system controls . . . . ICIS reviews develop and address specific threats, their associated dollar risks, and the risk reduction achieved by individual controls and networks of controls. This in turn allows an organization to be fully cognizant of its maximum potential system exposure, as well as to clearly demonstrate reasonable assurance that such exposure has been reduced to an acceptable level.

ICIS is not a checklist, 'yes no' type approach to internal control evaluation. Instead, listings of specific threats (errors and irregularities), and their resulting maximum potential dollar exposure are developed. Expected threat occurrence rates (including dollar exposure or risk) are determined, and all mitigating controls (internal and external) and their individual collective risk reduction capability are computed. The result is a readily understandable and clearly documented series of "threat paths" showing initial exposure, risk reductions achieved by specific controls, and a remaining untreated risk after all controls have come into play.

Threats are grouped into clusters of associated type errors and irregularities, and upon conclusion of the review an overall chart or matrix is developed to show the total threats treated and risk reduction achieved by each control "across-the-board." This allows for a simple cost-benefit analysis of individual existing controls, as well as a method to evaluate the full impact of control additions, deletions, or modifications being considered by the review team. [Ref. 40: p. 7]

ICIS' strength is that:

. . . DON management will be able to clearly demonstrate:

a. Maximum potential system exposure or risk.

b. Reasonable assurance that this exposure has/has not been reduced to acceptable levels in the most efficient and cost effective manner possible.

c. Clearly documented and readily reviewable evidence as to the degree with which GAO general and specific internal control standards have/have not been met. [Ref. 40: p. 8]

Table 6 presents a detailed side-by-side comparison between the conventional and ICIS approaches to internal control review.

TABLE 6

ADVANTAGES OF ICIS METHOD OF EVALUATING INTERNAL CONTROL SYSTEMS

	Conventional	ICIS
Artificial distinction between accounting and administrative controls	Yes	No
Entire system included in review	No	Yes
All internal and external controls fully considered	No	Yes
Detailed listing of specific threats to which the system is exposed	No	Yes
Detailed listing of operating controls	No	Yes
quantitative measurements of:		
Threat exposure	No	Yes
likely occurrence rates	No	Yes
Risk reduction achieved by individual controls	No	Yes
Uncontrolled risk	No	Yes
Logical grouping of similar threats	No	Yes
Threat/control matrices	No	Yes
Total system-wide risk reduction capability by control	No	Yes
Well documented/readily defensible reasonable assurance that internal control risks have been reduced to an acceptable level	No	Yes
Fully demonstrates compliance with GAO internal control standards in the most effective and efficient manner possible	No	Yes

[Ref. 40: p. 8-9]

ICIS is a microcomputer model for decision-making under conditions of uncertainty. Although it is powerful and innovative, it has two distinct weaknesses. The first weakness is in determining the specific annual dollar amount of risk associated with each identified threat; risk is defined as the annual amount of dollar damages that an activity could incur due to uncontrolled ocurrences of the threat, for example, deliberate contract overpayments under a kickback scheme. The dollar

assignment is necessarily heuristic and therefore, speculative. Unless the dollar assignment is done realistically, the estimated risk will be useless. Second, the expected threat ocurrence rate is also based on judgements, and hence, it is also highly speculative. These two weaknesses have the potential to cause erroneous results that would otherwise be valid.

6. **Planning and Controlling Audits**

a. Risk Analysis in Audit Selection and Execution

(1) *Introduction.* Naval Audit Service management identified effective audit selection and planning as another one of their top priorities. They are interested in ways that microcomputers can assist them in selecting audits. In particular, they are concerned with audit prioritization in terms of people required for the audit, and in terms of funds available to conduct the audit as a function of potential dollar savings to the Navy as a result of the audit.

(2) *Methods.* The principles underlying the ICIS program (that is, decision-making under uncertainty) seem to have potential for applications in the audit selection process. The Defense Contract Audit Agency (DCAA) developed a mainframe computer program prior to 1979 that was designed to help DCAA select audits with the highest potential payoffs. Payoffs were computed as contract savings to the government per audit hour. [Ref. 41] The DCAA program considers such factors as:

- Time since last audit
- Scope of last audit
- Personnel hours required during last audit
- Results of last audit
- Contractor response to audit findings

(3) *Specific software.* The Confidence Factor, by Simple Software, is a microcomputer program that analyzes up to 100 different alternatives using decision matrices, Monte Carlo simulation, decision tree analysis, critical path and linear programming techniques. This program quantifies subjective judgements using classic mathematical techniques.

The dialog is completely menu driven. The user performs all inputs to the program through a worksheet displayed on the monitor. Output is available in graph, chart and tabular format. The program labels the best alternative according to the algorithm employed. "What-if" calculations and interim results are also part of if the program.

A HELP facility is available for each algorithm, but only when the cursor is flashing. The HELP facility is oriented toward operation of the program. It is not designed to instruct users in statistics or the mathematical methods underlying each of the program's algorithms. Therefore, users must have a basic familiarity with statistical methods in order to understand the required input, output, and limitations of the information provided by The Confidence Factor.

A program such as The Confidence Factor could be used advantageously by the Naval Audit Service to select proposed audits during annual audit planning. Qualitative factors could be assigned numerical rankings and entered into The Confidence Factor along with quantitative factors, such as travel costs, required number of auditor hours, and priority. Then output from The Confidence Factor could be used, along with management's judgement, to develop the annual audit plan. This provides an objective and logical basis for selecting audits and for supporting the final audit plan. Another way such a program could be used is to rank aspects of audit findings, such as materiality levels and subjective evaluations of internal control. Such a ranking, combined with program calculations, could decrease audit risk and enhance the validity of the audit report.

b. Audit Scheduling and Tracking

(1) *Introduction.* "Due professional care is to be used in conducting audits . . . [Ref. 16: para 103.1.c]" The auditor-in-charge is responsible for exercising due professional care when conducting an audit. One of his professional responsibilities is to assign specific dates to audit tasks and to assign personnel to complete these tasks within the specified times. Along with scheduling, the auditor-in-charge must monitor the progress of his auditors against the established time schedule.

(2) *Microcomputer-Based Methods for Audit Scheduling.* Project management and scheduling software can be used to assign and to monitor auditing tasks. There are many programs available. The simplest of these programs provide the capability to assign personnel, and start and stop dates to individual tasks within a project. The program output may be in tabular or simple bar chart format. Advanced versions of project management software use statistical methods to compute useful planning information such as earliest start and stop times, slack time, critical paths, estimated early and late completion times, project costs, project labor hours and other management information.

(3) *Specific Software.* Project Scheduler, by Data Consulting Group, is a simple project management program. It displays simple projects in screen graphics, limited to 14 tasks at one time. The program displays data on a daily basis and indicates whether the data are proposed, non-critical, firm/critical or completed, along with a user-defined status code.

The dialog is menu and command driven, selectable at the user's option. Project Scheduler has on-line help screens, and according to the designer, has sophisticated techniques to prevent data entry errors. And, although the program is simple, its advantage is that it is effective for simple projects where a more sophisticated program could be cumbersome.

Harvard Project Manager (HPM), by Harvard Software, Inc., is a sophisticated program that performs project scheduling and tracking using PERT/CPM algorithms. HPM displays data in three forms--flowchart (called roadmap), schedule (GANTT chart), and calendar; all three displays are available either on-screen, or on printed copy. HPM also includes a file save and retrieve routine with a backup feature. HPM utilizes milestones, nodes and tasks with the capability to reference subtasks in other project files. Each task stores a 60 space description, scheduled and actual start and stop dates, earliest and latest start and stop dates calculated automatically based on previous nodes, planned duration and planned cost, and actual duration and actual cost. Slack is computed for each task and the entire project. There are six possible printed reports for each project. The reports are the roadmap, schedule or GANTT chart, calendar showing working days and holidays during the project lifetime, detail listing for each task, status of each task sorted by either responsible person or amount of slack, and project data formated and printed to a file for reading into database programs or spreadsheet programs.

The dialog is completely menu driven, except while in the roadmap which uses a graphics cursor to move between symbols directly on the flowchart. For experienced users, this exclusive use of menus could become tedious if HPM were not a relatively fast executing program. The program is user-friendly and easy to use. The HELP facility is primitive to the point of being unnecessary.

Errors experienced while using the program commonly occurred in assigning completion dates to tasks that were out of sequence with prior tasks that had to be completed first or in assigning completion dates prior to start dates. HPM verifies all task dates before allowing an updated task to be stored and displays an

error message, indicating the exact error, that must be acknowledged by the user before HPM proceeds with program execution.

EMPACT, by Applied MicroSystems, Inc., is another project management program that uses GANTT chart graphics to represent information. EMPACT will define a maximum of 250 tasks per project. Status of the project is provided as a funtion of scheduled duration versus actual duration and includes responsibility and task priority. The program automatically calculates end dates and highlights overdue tasks. The dialog is a spreadsheet style, on-screen editor that allows modifying schedules directly on the GANTT chart. Eight standard reports are available with a custom report generator included in the program. HELP is available on-line. However, a copy of the software was not available for review and therefore no comment is made on the adequacy of the HELP facility.

Personal Computer Project Management (PCPM), in the public domain, ". . . is a system of interactive programs for project management using the critical path method [Ref. 42: p. 1]." PCPM considers holidays, subcontractors (this could be useful in multilocation audits), cash flow, and slack. PCPM can produce a critical path analysis report, cash flow analysis, subcontractor analysis and nodal analysis. Reports can be sorted in a variety of ways to suit the user's desires. PCPM is written in BASIC.

The dialog is through interactive menus. Figure 3.26 shows the PCPM main menu. However, if desired, the user may generate input files using a line editor or a word processor in non-document mode. The program does not have the capability to display the nodes in a window while the user is executing the various program options. This missing capability requires the user to have a printed list of nodes available for reference while working with the program. In addition, there are no on-screen graphics to give the user a picture of the overall network.

PCPM does not have a HELP facility. But with the user's manual in hand, PCPM is easy to use. However, the sequential nature and the slow speed of the BASIC interpreter limits PCPM's usefulness to projects with 100 or less tasks. Table 7 provides a subjective comparison of the project management programs presented above.

TABLE 7

SUMMARY OF COMPARISON OF PROJECT MANAGEMENT PROGRAMS

	HPM	PCPM	EMPACT	Project Scheduler
Cost	$395	$35	$150	$75
HELP Facility Usefulness	Poor	Poor	Unknown	Unknown
Ease of Use	Excellent	Very Good	Unknown	Unknown
Power/Sophistication of Available Algorithms	Outstanding	Very Good	Unknown	Unknown
Speed	Excellent	Very Good	Unknown	Unknown
Efficient Memory Use	Outstanding	Very Good	Unknown	Unknown

Note: Scale from - Outstanding
Excellent
Very Good
Good
Poor
Unknown (if software was not tested)

c. Audit Announcement Letters

(1) *Introduction.* "The commander of the audited activity is to be given at least 30 days advance written notification of an audit . . . . Appendix E provides a sample format for announcement of periodic audits . . . [Ref. 16: para 403.1]"

(2) *Microcomputer-Based Methods for Audit Announcement Letters.* The microcomputer can be used effectively to create audit announcement letters. There are several different methods. The two most common methods use wordprocessing software and database software to maintain a list of commands and mailing addressses and to automatically generate the form letters for each command. Word processing and database software will be discussed in detail in subsequent sections; they are introduced briefly here in conjunction with this discussion of audit planning tools.

(3) *Specific Software.* Wordprocessing software, with a document merge function, is the most common software used for managing form letters. Wordstar uses Mailmerge and MultiMate uses its Merge routine. Both will combine a file of addresses with a basic form letter to produce individualized letters and envelopes. Each program

has unique features that distinguish it from the other programs. Mailmerge will pause at pre-programmed places within the letter and allow the user to insert comments that are unique to a particular addressee but inappropriate for the general population of form letters; the result is a personalized letter, mass produced. The MultiMate merge function will skip blank fields, such as those found in address files with extra lines for corporate addresses, when the field is not used.

Maintaining the address file is cumbersome with a wordprocessor whenever the file contains more than 50 addresses; most word processors perform file searches sequentially. Sequential searches are slow and inefficient. Additionally, word processors do not have data entry validation and verification routines. Database programs, however, employ validation and edit checking routines and are efficient address file management tools. Depending on the particular database program employed, the number of addresses in the file can be virtually unlimited. After changes to the address file are made, the database program report generator can produce a new address file in ASCII text format for importing into the word processor.

d. Audit Questionnaire

(1) *Introduction.* Naval Audit Service headquarters uses an audit questionnaire to obtain feedback from selected commands that are audited [Ref. 16: para 613.9 & App L]. This feedback is considered in developing subsequent annual audit plans.

(2) *Methods and Specific Software.* Spreadsheet software, such as Lotus 1-2-3, is useful for tabulating, analyzing, and displaying the questionnaire results. By maintaining the data in tabular form, 1-2-3 can run statistical analysis on the data, and display the data in many different ways, including graphically. Long-term and short-term trends can be pin-pointed, easily.

e. Team Selection

(1) *Introduction.* The Naval Audit Service's stated objectives in assigning auditors to all categories of audits are, in part:

a. Make each audit team large enough to allow for completing the audit within the established CALDAY (See Appendix A).

b. Provide teams balanced as to number, experience, and specialized knowledge and skills--as related to the complexity and type of individual audit assignments.

c. Assure that there is a sufficient number of experienced auditors on each team to provide required on-the-job supervision, technical expertise, and training to junior auditors and trainees.

d. Assign and release auditors in increments needed to prevent unnecessary "loading" at any time during an audit.

e. Assign auditors in a manner that, over a period of time, will enable them to receive a variety of experience and opportunity commensurate with their ability, performance, and career needs, and the future needs of NAVAUDSVC . . . [Ref. 16: para 404.1]

(2) *Methods and Specific Software.* To meet these objectives, managers could maintain records of each auditor's work experiences by useful categories, as well as by the specialized audit skills of each auditor. This type of recording of information is easily handled by most database programs, such as dBASE III, R:base 5000, PC-File III and others. The manager may query the data files and extract reports listing those auditors with the desired skills and experience. If the database is frequently updated to reflect the changing skills of each auditor, the manager will be able to make informed audit assignments based on up-to-date, documented skill rather than on hit-or-miss heuristics.

7. General Management and Administration Applications

a. Budgeting

(1) *Introduction.* Travel funds to send auditors to audit locations and funds to hire and pay auditors salaries are the major portions of the annual budget for the Naval Audit Service. Effectively allocating budgeted funds and controlling the expenditure of budgeted funds during budget execution are important aspects in the accomplishment of the annual audit objectives for the Naval Audit Service.

(2) *Microcomputer Methods for Budgeting.* The microcomputer can manage and manipulate budget information quickly and accurately. It can present budget information in many different formats so that each format presents a unique budget view to the audit manager for decision-making purposes. The audit manager can prepare the initial budget, assisted by a microcomputer, revise the budget as the fiscal year progresses, and use the budget to forecast and prepare future budgets.

fiscal year progresses, and use the budget to forecast and prepare future budgets. Microcomputers are capable of calculating, in minutes, wthat would take humans hours (or even days) to calculate. Managers can harness the speed of the microcomputer to quickly determine the effect of proposed changes in travel plans and personnel on their budget.

The microcomputer can present budget data in spreadsheet (i.e., tabular) and graphic formats. Spreadsheet format is useful for detailed analysis of individual budget line items. Graphic format is useful for overviews, executive summaries, and highlighting data on the extreme end of budget limitations.

(3) *Specific Software.* Electronic spreadsheet software is readily adaptable to budget analysis. Budget summaries developed with pen and paper are often designed in row and column format. In fact, the Navy Comptroller's standard budget summary (NAVCOMPT Form 2179-1) is a columnar form with columns and a row for footing and crossfooting. This format is easily converted from pen and paper directly to electronic spreadsheet. The advantage of an electronic spreadsheet presentation of budget information over the pen and paper presentation is that managers can see the effect of budget changes on the entire budget on the computer display screen without re-writing the entire budget summary. The electronic spreadsheet can recalculate the entire budget on a single keystroke, even for a change in just one amount. Also, the microcomputer can re-draw graphic presentations and charts in a few seconds. Figure 3.27 shows an hypothetical, monthly regional financial report prepared with Lotus 1-2-3. Figure 3.28 shows the information graphically.

Management Control, by Fox and Geller, is a program that can analyze data produced by 1-2-3, MultiPlan, SuperCalc, or build its own data files. According to Fox and Geller, Management Control:

- Manages 5 kinds of data: actual, budget, forecast, last year, next year
- Can use an actual organizational chart to manage divisions or departments
- Can vary the assignment of the months and quarters of the fiscal year
- Displays, graphs, and explains budget variances
- Contains 13 pre-programmed financial reports, and 8 kinds of color graphs
- Can perform 3 and 4 dimensional financial analysis [Ref. 43]

The program software was not available for testing and no comment is made on the program's various features.

b. Organizing and Controlling Work Assignments

(1) *Introduction.* Successful completion of any task results, in part, from proper planning and ensuring that personnel meet established deadlines. This section discusses how to employ microcomputer software to plan and track the progress of work assignments.

(2) *Microcomputer-Based Methods for Controlling Work Assignments.* The project management software discussed in previous sections (i.e., HPM, PCPM, and etc.) can be used to manage audit assignments. One distinct disadvantage with most of these project management software packages is their lack of the capability to produce detailed financial reports by specific cost categories within the assignments of a particular project. These software packages also do not track backlogs in a detailed manner. Nor do these packages evaluate team performance or productivity.

(3) *Specific Software.* The Work Management System, by the LWFW Group, was originally designed to meet the planning, scheduling, cost reporting, and forecasting needs of state and local governments. However, its design makes it suitable for the Naval Audit Service to employ in organizing and controlling audit assignments.

The software can be tailored to individual needs. It will generate backlog reports. The Naval Audit Service can use these backlog reports to make necessary changes in audit schedules affected by the backlogs; and re-assign personnel to balance audit team composition.

The software will allow estimates of audit costs to be compared with actual costs as the audit progresses, on a daily basis. The software will generate cost reports by type of audit, by audit site, by individual auditor, and by major functions within the audit. Detail distributions of labor hours, labor rates, and total costs are standard applications. Additionally, the software can report on major cost trends.

The benefits from such information are several. First, the cost and labor information can be used to justify budgets and personnel hirings when matched against annual audit plans. Second, prioritized decision-making, related to which audits should be performed and by whom, is easier to make when detailed costs can be compared against a prioritized list of objectives.

The actual program was not available for testing and, no comment is made on its operation. But, from the claims of the designer, the program is potentially useful to the Naval Audit Service. The major disadvantage of The Work Management System is its high cost--in excess of $3,000.

c. Word Processing

(1) *Introduction.* The current policy in the Naval Audit Service is that word processing is not the auditor's responsibility. As such, the Naval Audit Service guides auditors away from word processing as an ineffective use of audit manhours. However, all auditors communicate. The hallmark of a potentially good auditor is the ability to communicate ideas, findings, and facts clearly and succinctly, especially in writing. The microcomputer has the potential to replace pen and paper, and thereby increase the efficient (and thus indirectly, also the effective) use of audit manhours. Certainly, the auditor who composes his thoughts to floppy disk makes them easier to incorporate in automated audit reports. Certain applications of word processing are appropriate for auditors to perform themselves, especially where the auditor must create a rough draft on paper anyway.

(2) *Methods for Utilizing Word Processing in Audit Work.*

> Word processing software permits the auditor to efficiently record, store, access, and modify standardized audit correspondence. For example, many engagement letters contain wording that recurs each year or is applicable to a large number of audit clients. The auditor can easily and quickly copy the standardized portions of these letters and enter the client-specific portions to produce a specific engagement letter . . . . Word processing simply allows the auditor to modify standard letters for particular client circumstances in an efficient manner.
>
> The auditor may use the microcomputer to develop customized audit programs for each client. Using word processing software, the auditor can review a standard audit program and add, delete, or modify procedures according to particular engagement needs. Senior members of the audit team can quickly modify the audit program in response to changing engagement conditions. In subsequent years, the program can be updated more efficiently. [Ref. 27: p. 32]

Although the comments above are intended for public accountants, the uses described for word processing software are directly applicable to the Naval Audit Service.

Word processing software abounds in the commercial software marketplace. The many different word processing programs are targeted to different users. There are personal, professional, corporate, scientific, typesetting, and most recently, outline producing programs. This discussion is concerned with personal, professional, and corporate word processors.

> *Corporate* word processors are designed to meet the needs of the clerically staffed word processing departments typically found in large corporations. *Professional* word processors are designed for professional writers, business analysts, executive secretaries, researchers, and academics who do their own document creation and editing. *Personal* word processors are meant for use by executives and other occasional PC users, such as home users. [Ref. 44]

(3) *Specific Software.* Most of the word processors on the market as of the writing of this thesis have the same or remarkably similar capabilities and functions. Their differences lie in the way they accomplish these functions. These word processors differ in speed, memory requirements, handling of pages and blocks of text, file backup (or lack thereof), spell checking capacity, list handling (or merging), and ability to operate with a wide range of printers. The ensuing discussion will concentrate on these differences.

WordStar, by MicroPro Inc., was the first 'full-featured' word processor designed for the microcomputer. WordStar was originally designed for the CPM-based microcomputers (e.g., the Apple). Later, it was re-written to operate under the MS-DOS environment found on IBM and compatible microcomputers. Although it is an early generation word processor, it is still widely used. Its wide use verifies its strong capabilities and popularity.

Since WordStar was written for 8-bit, CPM-based microcomputers, it is faster when running on 16-bit, MSDOS machines. In the early days of personal word processors, this speed gave WordStar an advantage over other word processors. [Ref. 45]

WordStar is designed to run in only 64K bytes of RAM. The practical effect of this is that WordStar works on single pieces of documents in memory, rather than wholely defined pages or entire documents. The advantage of this is that the size of a document is unlimited by the computer's memory, since WordStar can swap pieces of a document in and out of memory when needed. Thus, the length of a document is only limited by the amount of external storage. External storage can be extremely large--10, 20, 50, 100 or more megabytes.

WordStar allows three options for setting page length. WordStar will automatically establish a page break, based on the user-selected page length. Or, the user may turn off automatic paging and establish 'forced' page breaks wherever desired in the document. And finally, WordStar will allows the user to insert 'forced' page breaks while automatic pagination is turned on. Pages are not treated as unique entities in WordStar. Therefore, moving, copying, and rearranging text across pages is not constrained by the page boundaries.

WordStar handles block operations (i.e., move, copy, delete, write) in a somewhat awkward manner. First, the user marks the beginning and ending of the block of text with 'block markers'; then the user executes the block operation. A more natural way to mark text is by moving the cursor over the text.

WordStar creates a back-up copy of every document saved to external storage. The back-up, starting with the second edition of every document, is a copy of the edited version of the document as it existed before the current changes. Thus, if the current edited version of the document is lost during edit for any reason (e.g., power loss, computer failure, etc.), the user can recover the document by re-starting the edit session with the back-up. Only the current changes will have been lost. WordStar warns the user when the external storage device runs out of sufficient space to store both the document and its back-up.

A spelling checker is not an integral part of WordStar, but SpellStar and CorrectStar are available to run inside of WordStar. Different versions of SpellStar, which has been superseded by CorrectStar, have different numbers of words in the dictionary, usually starting with 20,000 words. But, the user may add and delete words to SpellStar whenever desired. CorrectStar is a 65,000-word checker that gives the user several possible correct spellings whenever it encounters a spelling error. It is much more sophisticated than SpellStar.

WordStar handles lists through MailMerge. MailMerge will print form letters with as many different variables as the user needs. In addition, the number of form letters produced from one file is only limited by the number of addressees in the address file. MailMerge handles mailing labels and envelopes in addition to form letters. MailMerge is simple to learn and will read list information from files created by several different database programs, including MicroPro's InfoStar, PC-File III, dBASE, and others. Alternately, the user can create lists using WordStar.

WordStar is configured by MicroPro to run with over a dozen common printers. And, MicroPro provides instructions and an installation program to allow the user to customize WordStar to operate with printers not configured by MicroPro.

MultiMate, by MultiMate International Corp., is based on the Wang Professional word processing system. The Wang word processor was the first word processing software to be widely used by secretaries and typing pools on corporate, dedicated word processing computers. Thus, many people who word-processed in their daily work environments were weaned on Wang word processing. MultiMate, like the Wang program it emulates, is designed to operate as closely as possible to the way in which a secretary types and edits revised documents--one page at a time. The MultiMate cursor lags behind the typist above speeds of 30 words per minute. This is annoying but does not cause any data loss. [Ref. 46]

MultiMate works with only a single page in memory, even though it requires 256K of RAM in which to run. It swaps pages in and out of memory to move between pages; this is the way most secretaries work with documents. The disadvantage of this is that MultiMate must perform a 4 to 5 second disk access per page. This disk activity slows down processing time with a multiplicative effect when editing between many pages in a document. The advantage is that each page is saved during every disk access; so, losses due to system crashes and power failures are limited to the current page in memory. Block operations are handled by moving the cursor across the text to be blocked before executing the desired block command. [Ref. 46]

MultiMate's greatest weakness is its lack of file back-up capabilities. MultiMate erases the preedit version as each page is edited and saved to disk.

MultiMate has a spellchecker with an 80,000 word dictionary and provision for adding more words to a supplemental dictionary. Not only does the spellchecker flag words not in its dictionaries, it proposes possible correct spellings. [Ref. 47: p. 183]

For list handling, MultiMate uses the Merge function. The Merge function is difficult to use. The document and the list must be formatted precisely and without errors or the merge will fail. The list must be in MultiMate readable format. MultiMate will not accept files created by database programs, unless those files can be converted to MultiMate format.

MultiMate uses print driver files to control printing. MultiMate International Corp. provides driver files for more than 40 different makes and models of printers. In addition to these, the user may build customized print drivers using a utility program provided with the MultiMate program.

EasyWriter is written by Information Unlimited Software. The best that can be said for EasyWriter is that it is easy to use. Its speed is mediocre, and its editing capabilities are quite basic. However, EasyWriter can easily fill any need for simple word processing of short documents, such as single-page memos. It requires 128K of RAM. This large memory requirement is considered to be excessive in view of EasyWriter's limited capabilities. EasyWriter stores the entire document in memory while editing. The maximum size of a document depends on the amount of RAM available. 128K of RAM will allow a document approximately 5,000 words long. EasyWriter defaults to 54 lines per page with automatic page breaks. However, both page length and page breaks are variable as the user desires.

Block operations are the same as in other word processing programs, except that the block size is limited to 4,000 characters. However, EasyWriter has a unique and sometimes convenient 'undelete' command. The 'undelete' permits recovery of up to 62 characters of deleted text, until the next delete command is executed. EasyWriter, unfortunately, does not have any file back-up capabilities. It defers to the microcomputer's operating system for file duplicating operations. EasyWriter does not have a spellchecker or a list manager.

EasyWriter, like MultiMate, uses print drivers to support attached printers. EasyWriter supplies print drivers for most printers. And it also allows the user to build a customized print driver for unsupported printers.

Microsoft Word, by Microsoft Inc., is fast--faster than WordStar. It is unique in that it allows using a mouse along with the keyboard, and it can display text using graphics. The advantage in using a mouse is that defining a block of text and using a menu is very fast. Graphics display of text lets the user see the effect of bold face print, underlining, italics, and other special print features on the monitor, without printing the document to paper. In addition, the user may write macros for repetitive commands and special style formats which must be prepared to exact specifications (such as this thesis, for example) [Ref. 48].

Microsoft Word requires 256K of memory. Although this is a large amount of memory, all editing, changes, deletions, insertions, and formatting are performed in RAM. Microsoft Word automatically executes page lengths, format, and breaks, once established by the user; or, the user may accept the defaults. Block operations are quick and simple, with the blocks highlighted in inverse video. File backup is available during edit. But, after the document is saved to disk, the pre-edit document is overwritten. The only way to have true back-up files is to make another copy of the document file on another disk. [Ref. 48]

The spellchecker is adapted from Oasis Systems' The Word Plus. It has a large dictionary and offers alternative spellings for errors. The mail-merge facility offers conditional constructs for highly sophisticated batch processing. [Ref. 48]

Microsoft Word currently supports all printers manufactured for use with personal computers. Table 8 provides a subjective comparison of the word processing programs presented above.

TABLE 8

SUMMARY OF COMPARISON OF WORD PROCESSING PROGRAMS

	WordStar	MultiMate	EasyWriter	Word
Cost	$135	$235	$50	$300
HELP Facility Usefulness	Excellent	Good	Good	Excellent
Ease of Use	Excellent	Outstanding	Excellent	Very Good
Power/Sophistication of Available Algorithms	Excellent	Excellent	Good	Outstanding
Speed	Outstanding	Excellent	Excellent	Very Good
Efficient Memory Use	Outstanding	Very Good	Poor	Outstanding

Note: Scale from - Outstanding
Excellent
Very Good
Good
Poor
UnKnown (if software was not tested)

8. **Fixed Assets and Inventory**

a. Auditing Fixed Assets

(1) *Introduction.* Naval Audit Service reviews of fixed assets (i.e., plant, property and equipment) usually involve verification that the asset exists, that assets in existence as of the last audit but no longer available were removed according to law or regulation, that the assets are permanently marked as government property, that serial numbers are recorded, that records are properly maintained, and that assets are adequately safeguarded. The review may also include a verification of procurement and receipt records.

(2) *Microcomputer-Based Methods for Auditing Fixed Assets.* The review process can range in complexity and depth from simple perusal of command records to conducting physical inventories of assets and tracing those assets back to their procurement authorizations.

(3) *Specific Software.* Electronic Spreadsheet programs, such as Lotus 1-2-3, are useful for listing information collected during the review process in an organized manner.

Database programs, such as dBASE III Plus, are useful in establishing information in databases which can be used comparatively on successive audits of the same command. The database program, depending on it sophistication, can be used to query the data for almost any relationship desired by the auditor.

b. Auditing Inventory

(1) *Introduction.* The Navy maintains inventories of war materials, food, repair parts, and general operating supplies that are valued in excess of several billion dollars. Auditing naval inventories is a large responsibility simply due to the high monetary value and the great quantities of items in the inventories. The microcomputer can be used to reduce the tedium involved in the collection, analysis, and presentation of the results of inventory audits.

(2) *Microcomputer-Based Methods for Auditing Inventory.* One way in which microcomputers can assist auditors during inventory audits is in statistical sampling Microcomputer software can select sample size and sample population, and record and analyze sample data. Statistical sampling with the micromputer was discussed previously. Additionally, microcomputer software can assist the auditor in recording the results in worksheet format that serves two purposes: (1) results are in a presentation-quality format, and (2) the microcomputer can perform mathematical and statistical analysis on the data as it is entered on the worksheet, without additional formatting.

(3) *Specific Software.* Any of the electronic spreadsheet programs are useful to the auditor during random sample inventory counts. In our example, a Lotus 1-2-3 template is used to generate a list of random stock numbers, in Navy Item Identification Number (NIIN) format. The template contains a macro to generate the NIINs. In addition, the template is set up in work paper format ready for the auditor to enter his findings. After entering all his findings, the auditor executes the spreadsheet calculate command; the computer calculates the statistical analysis in a few seconds, and produces the numerical output shown in Figure 3.29 and the graph shown in Figure 3.30.

---

[3]Note the difference between the two spellings *data base* and *database*. *Data base* represents a collection of *data*. Whereas, *database* represents the *technology* surrounding the storage, retrieval, and manipulation of the data in the data base.

9. Database

a. Introduction to Database

A data[3]base is a collection of information. The information usually is interrelated, though this is not a requirement. Database software exists to make storing and using information easy, efficient, and helpful.

Database software exists in two varieties for the microcomputer--as a file manager, and as a relational database manager. A file manager can only work with one file at a time. This limitation is overcome in a relational database manager. The relational database manager is capable of using information from multiple files, concurrently. [Ref. 49: pp. 4-5]

Database programs are useful whenever data must be collected and stored for later use. The applications for database software are limited only by the imagination of the user.

(1) *Microcomputer-Based Methods for Using Database Software in Auditing.* Database software can store names, addresses, telephone numbers, dates, notes, procedures, lists, and any other information which can be translated into words, numbers, or boolean conditions. In one application, a database program is used to maintain mailing lists for creating audit announcement letters. Another application is storing information concerning auditor experience and qualifications. Still another application could store information about audit findings and follow-up action taken (or yet to be taken). The database program, in each of these applications, can generate reports in many different sequences providing the auditor with different views of the data that he might not be able to get from a manual collection of data, without expending such a great amount of effort that the cost of retrieving the information would outweigh the benefit of having the information.

(2) *Specific Software.* PC-File III, by Buttonware Inc., is a simple and easy-to-use, but efficient file management program. Several versions exist. One version is in the public domain. Installation of the program is uncomplicated; the program can be customized to the user's tastes. The program's capabilities, according to the user manual, are:

> PC-File is a general purpose "Data Base Manager" program. It is designed specifically for ease of use. With PC-File, it's very easy to create and maintain databases on the computer, and to create simple printed reports based on your data.
>
> You can use PC-File for all kinds of tasks:
>
> - Maintain mailing lists and print mailing labels, 1-up or multi-up.
> - Maintain price lists,

- Maintain telephone or name/address directories,
- Keep various types of inventory records,
- Build personnel databases,
- Keep customer lists,
- Build and maintain databases to be used by other programs, like Visicalc, Multiplan, 1-2-3, and Mailmerge,
- and many other tasks which only you can dream up.

PC-File will allow you to sort your data into almost any sequence. It allows rapid access to any record in the database, with a sophisticated search technique allowing comparison searches on any field in the record. For example, you can display all employees over a certain age, or all clients in a certain state, or all items that are not in a certain category. You can print out reports from your database, listing all or some of the fields, from all or some of the records, in many different sequences, with totals on the numeric fields. Reports can be sent directly to your video screen, or to any one of many different types of printers. They can also be sent to disk, for later use with your word processing programs.

You can create entire new databases from existing databases. The new database can be in a different format, and can be a subset of the database from which it was "cloned". New fields can be added, old fields can be deleted, field positions can be rearranged, and field sizes can be lengthened or shortened.

You can export your databases for use with Multiplan, Visicalc and other "calc" programs, or to "MailMerge" files. [Ref. 50]

PC-File III has a maximum field length of 65 characters, maximum field name length of 12 characters, maximum fields per database of 41, maximum record length 1,430 characters, maximum records per database of 10,000, maximum number of sort control fields of 10, and a maximum number of compares for print record selection of 10. "Records are added one by one, each displayed separately. You can then modify, delete, display one record or browse through all, and find records through wildcard, and scanning [Ref. 51]."

The PC-File III reporting function is a long and cumbersome process of setting up report formats, field selection, record criteria and other required preparations [Ref. 51].

InfoStar Plus, by MicroPro International, is another file management program.

When you bring up *InfoStar*, a menu . . . with five choices appears. After you select appropriate choices from first-and-second-level menus, you can begin to develop a file input form by entering information on a blank screen. You denote input fields by typing the underline character a specified number of times to establish field width. . . .

After you've created an input form, you must choose a key field. Then you may assign attributes to any of the fields. This feature allows for sophisticated data entry procedures and error checking. . . .

One of the more sophisticated error-checking attributes is called file verify. Here you may enter a state abbreviation such as NY in a State field. If you have assigned a file verify attribute to the field, *InfoStar* will automatically check your entry against a file that has state abbreviations. To keep track of any attributes you may have assigned to fields in a record, you can print them out.

Help screens are ubiquitous in *InfoStar*, normally occupying the upper third of the screen. An they are needed, too, at least until you become very familiar with the product, because most commands are control key commands.

Some of *InfoStar's* menu selections, commands, and modes are not as clear or intuitive as they could be. If you want to search for a record, for example, you select Enter Data from the menu. Then once the form appears, you select "edit scan M ask" to conduct your record search. In other parts of the program, you select a command that says "Save form and boot operating system", which actually returns you to the menu from which you started. Luckily, these examples are not typical of all the selections you make with *InfoStar*. . . .

The program can generate two kinds of reports: the quick report and the custom report. With the quick report, *InfoStar* does most of the work; with the custom report, you paint a layout on the screen and embed somewhat cryptic commands similar to the dot commands *WordStar* uses.

In one sense, the report generator, like the file manager part of the program, has sophisticated capabilities. It can generate reports with fields from more than one file, for example. But when I tried to generate a simple report that had breakpoints done a certain way, the quick report feature couldn't handle it, and the custom report feature did so only with some difficulty on my part . . . [Ref. 52]

dBASE III Plus, by Ashton-Tate, is a programmable, relational database program. Programability allows advanced users to build a program shell around the data base. This program shell manipulates the data base in either the interactive or batch mode for unique applications. The program becomes the human's surogate for repetitious tasks. The program takes on the responsibility for data-checking, editing, verification, and maintenance of the data base.

dBASE III Plus has over 50 different commands to perform as many operations on the data base. Among its more powerful commands are an interactive query, views that establish relationships between files, catalogs that group files together and make file selection easier, expanded debugging assistance, error trapping, and sophisticated report generation. The program includes a screen painter[4] and has linked screens that decrease the need to put every data field in a relationship on the same screen--the result is easier to read data entry screens [Ref. 53].

[4]See Appendix A for a further explanation of screen painter.

dBASE III Plus dialog uses pull-down menus (in the 'Assist' mode) for every function; these make beginners comfortable using the program. Advanced users may run dBASE III Plus entirely in the command mode, without slowing down for menu operations.

The HELP function is always available by pressing the F1 key in Assist mode, or by typing 'help' and the name of the command requiring help. The HELP displays are lengthy summaries of the instructions found in the user manual. They are quite adequate, even for beginners.

dBASE III Plus was used to develop the audit application library program discussed in Chapter 2. This program will cross-reference audit program steps to audit program number, specific audit type, and auditor. It was developed specifically for this thesis to demonstrate dBASE III Plus' capabilities.

R:base 5000, by Microrim, is another programmable, relational database management program, with capabilities similar to dBASE III Plus. A unique feature is its 'Application Express'. This is a menu-driven utility for designing and implementing database applications. The user designs a menu then assigns tasks to each menu. The Application Express then generates the R:base code required to run the application. [Ref. 54: p. 101]. With its menu-driven dialog and Application Express, R:base 5000 is generally very easy to use. In addition to the basic program, R:base 5000 has several peripheral utilities:

> Clout, for example, is a conversational language program that uses a form of artificial intelligence and allows the use of straightforward English commands to access data from R:base databases. In fact, the program not only comes with a dictionary of words that it recognizes, but also allows users to create special dictionaries for each specific database created. Through this facility, users can retrieve data without having to remember esoteric commands; they merely request information from the program as they would from a person . . .
>
> Also available are the Extended Report Writer and the Program Interface. The extended Report Writer . . . is an output formatting utility that gives R:base users extended capabilities to handle more complex reporting requirements than possible using the normal R:base *Report* command. The Program Interface . . . is a library of routines that allow Pascal and Fortran programs to access R:base files [Ref. 54: pp. 103-104].

The HELP screens

. . . are a definite plus, despite the fact that they are in part deficient. Users can access any one of **50 help screens** from anywhere in the program; by typing *Help* users are presented with a general help screen that lists all 50 commands that have an accompanying help screen, and from there users can easily view each help screen. If users are in the midst of an operation and know which command

they need help with, they need only type 'HELP' and the appropriate command word, e.g., *"HELP DEFINE"*.

The problem with the help screens is that they offer only a basic explanation of the R:base commands with just a paragraph devoted to each. Since users must leave the screen that they are working with in order to access help, it would be an excellent benefit if a more thorough explanation that included real-life examples accompanied each help screen. [Ref. 54: p. 108]

The error handling routines are integrated with the HELP function.

. . . If a user makes a mistake in the syntax of a command, R:base automatically brings up a schematic help screen that displays the proper syntax. This saves considerable time and energy [Ref. 54: p. 108].

R:base 5000 special features include a three level, optional password protection scheme for the database files.

3BY5, by Softshell Corporation, is public domain file manager program that emulates a 3 by 5 card file. It is a startlingly simple but highly effective file manager. It includes a simple word processor, based on MultiMate, that makes data entry almost effortless. Like any file management program, 3BY5 stores, searches, retrieves and outputs data. Searches may be done using multiple keys. 3BY5 will also read and search any WordStar, WordPerfect or ASCII document files. A maximum of 4800 characters are permitted in each record: a card is a record. The maximum number of records is limited only by the size of the disk used to store the records.

The dialog is completely menu-driven in a manner similar to Lotus 1-2-3. 3BY5 displays a 'card' on the screen into which data are entered as if creating a document in a word processor. The user may display up to 3 different 'cards' on the screen simultaneously. The user may also open (but only use one at a time) up to 3 different files and direct input and output to the desired card.

An on-line HELP facility is not available, but not needed. The user manual is complete and easy to read.

Simple programs have simple errors. Simple errors only need simple error messages. 3BY5 handles errors with four to six word, concise messages that leave little doubt about the error and the required correction.

Of the many uses for card files, we found that 3BY5 was almost indispensable for recording research notes. Notes can be entered in any sequence and retrieved later by searching for a keyword. References can be imbedded within the note, or written as a separate record in another file and cross-referenced to the notes file. For

the auditor, 3BY5 could be used to make notes about payroll records for which further research is required. Or, the auditor can write side comments to be incorporated later in his work papers. The possibilities are endless.

A special feature of 3BY5 is the capability to define an output file into which records from the card files can be output as ASCII text for import into word processors, electronic spreadsheets, and even other database programs capable of reading ASCII text files. Table 9 provides a subjective comparison of the data base programs presented above.

C. INTEGRATED SOFTWARE

1. Introduction

Most software products in use today operate independently of each other. This is not a problem until the user desires to use the output of one program as the input to another program. Usually, the user finds himself re-entering input. When composing a document that has text and graphics, such as bar charts, the usual method of presenting the graphics is placing the graph on a separate page as an attachment to the text. A better method would be to insert the chart directly into the text at the place where the author refers to the chart. Some families of software allow users to export data or text from one program to another, such as the MicroPro family of WordStar, CalcStar, and InfoStar. And still other programs are able to read the files and the output of a limited number of programs written by other companies. Lotus 1-2-3 can read dBASE III files and any ASCII file by translating the file to 1-2-3 format, for example. But in all these cases, the user must first quit the program he is currently running before using the other program to read in his data.

TABLE 9

SUMMARY OF COMPARISON OF DATABASE PROGRAMS

	PC-File	InfoStar	dBASE III	R:base	3BY5
Cost	$35	$150	$495	$695	N/A
HELP Facility Usefulness	N/A	Poor	Excellent	Unknown	N/A
Ease of Use	Very Good	Good	Excellent	Unknown	Excellent
Power/Sophistication of Available Algorithms	Very Good	Excellent	Outstanding	Unknown	Very Good
Speed	Excellent	Excellent	Outstanding	Unknown	Excellent
Efficient Memory Use	Excellent	Excellent	Very Good	Unknown	Excellent

Note: Scale from - Outstanding
Excellent
Very Good
Good
Poor
Unknown (if software was not tested)

2. Software Methods

Integrated software makes it easier for the user to quit one program before using another program. It makes time-consuming, error-prone file translations unnecessary and permits integration of text, graphics, mathematical computations in one document. It also allows the user to have several different programs running concurrently, i.e., word processor, electronic spreadsheet, and database manager all in one program. The end result is that by employing an integrated software package the user may accomplish in one program what heretofore required the use of four or five different programs. This program consolidation increases efficiency and reduces expended labor.

The cost advantage of integrated software over non-integrated software is very favorable. The cost to buy all of the separate, non-integrated programs that are contained in one intregrated program approaches three times the cost of one integrated program.

3. Specific Software

a. Framework II

Framework II, by Ashton-Tate, is an extremely powerful integrated software program that combines word processing (with an 80,000 word spellchecker, and mailmerge), file management, electronic spreadsheet, graphics (multiple colors, hi-lo-close graph, bar, stacked bar, line, scatter, x-y, and pie charts), outlining program ('idea processor'), a programming language (called 'Fred'), a full-feature telecommunications program that includes XModem file transfer protocol and terminal emulation, file import and export capabilities for WordStar, MultiMate IBM DCA/Displaywrite, Lotus 1-2-3, ASCII, dBASE and others. All of these functions are available to the user in a single program. The user does not have to change programs.

b. Symphony

Symphony, by Lotus Development Corporation, is another integrated software package that combines word processing, electronic spreadsheet, graphics, and database management into a single program. Its capabilities are strikingly similar to those of Framework II.

D. MISCELLANEOUS USEFUL SOFTWARE

1. Forms Management

a. Introduction

Every government employee uses some kind of form during his government service. Many government offices create localized forms for their own peculiar applications. Often, local forms go through many revisions before they become truly useful. Forms management software can ease the time and effort expended in developing and maintaining these forms.

b. Methods

Word processors and electronic spreadsheets are useful for forms management. However, there are several programs that are designed especially for forms management tasks.

c. Specific Software

EZ-Forms, by MaeDae Enterprises, is a public domain program that generates customized master forms. EZ-Forms will create or revise and then print forms for mass duplication by the local print shop. Also, EZ-Forms allows the user to recall a master form for an indefinite number of times, enter information in the blanks,

and store the form as a completed form. EZ-Forms supports IBM-compatible, Epson, and many daisy wheel printers.

The advantage of EZ-Forms over a standard word processor is in the way EZ-Forms handles lines, blocks, and pages of material. EZ-Forms draws lines, boxes, and borders using single keystrokes; word processors require each line to be drawn by single characters. Word processors draw boxes and borders awkwardly. EZ-Forms moves the screen by sections in addition to moves by line, as a word processor. This sectional movement allows creating and editing boxes of information without affecting other areas of the form.

EZ-Forms is not a full-fledge word processor. But due to its forms-oriented features, it is better for forms maintenance than a full-fledge word processor.

2. **Desk Top Manager**

a. Introduction

The traveling auditor often has a need for an alarm clock, calculator, typewriter, calendar, phone book, and scratch paper for notes on his desk while he works.

b. Software Methods

Programs are available that provide all these things as part of normal microcomputer operations. These programs reside in the microcomputer's memory and come out only when the user requests them. These programs hide in memory and allow other programs to run concurrently; the user does not have to terminate the running of his application program (i.e., word processor, electronic spreadsheet, database manager, etc.) to check his calendar, pen a small reminder note, or calculate a financial ratio. Nor does the traveling auditor have to lug all of these things with him in addition to his computer and printer.

c. Specific Software

(1) *Sidekick.* Sidekick, by Borland International Incorporated, was the first practical desk organizer. It was originally designed for programmers, not clerical persons; its pop-up calculator computes binary, and hexadecimal in addition to decimal; boolean logic calculations are also available as part of the calculator. It has a complete ASCII character translation table. It also has a notepad, calendar appointment book, and an auto-dialer. Its intended use notwithstanding, Sidekick is also useful to clerical persons.

Sidekick remains memory-resident, after loading, until the user presses the CTRL-ALT key combination. Sidekick freezes the currently running program and displays its main menu, with eight choices, on the screen. Figure 3.31 shows the main menu.

(2) *PC-Deskmate.* PC-Deskmate, by Alternative Decision Software, Inc., is in the public domain. It is a desk organizer similar to Sidekick, but intended for use in the clerical environment. As such, it has several unique features that can potentially boost office productivity.

PC-Deskmate, at the user's option, may be loaded as memory-resident, or retained for use as disk-resident. This is useful if RAM space is small. Figure 3.32 shows the main menu, the alarm clock, and the calculator. The alarm clock displays time, rings hourly chimes, can beep the computer's bell, display notes at preset times, and automatically start programs at preset times. The calculator emulates an adding machine, with a tape. The tape is a useful reminder in the event that the user is distracted. The calendar will maintain multiple calendars of important dates and appointments. Multiple calendars are useful for tracking daily routines for more than one person, or for multi-location audits. The typewriter emulator makes the printer operate like an electric typewriter, in two modes--character mode, or line mode. The user can set and change margin and tabs quickly and accurately; a ruler line is displayed, on-screen, under the cursor that shows a one-to-one correspondence between the position of the character on the screen and the printed character on the printer. The typewriter function is extremely useful for occasions when a word processor's mailmerge is too cumbersome for addressing a small number of envelopes. Figure 3.33 shows the typewriter emulator screen. In addition, PC-Deskmate can be configured for non-IBMcompatible printers. The memory-resident version of PC-Deskmate is invoked by pressing the alt-M key combination. But, the user can even change this key combination to suit his desires. A problem with memory-resident software is that it can be incompatible with other software.

IV. SURVEY OF CURRENT MICROCOMPUTER USE BY AUDIT ORGANIZATIONS

A. INTRODUCTION

The use of microcomputers for auditing and audit management tasks is a recent development. Traditionally, audits were performed manually. Hardcopy documents were reviewed and workpapers were prepared manually. Internal control procedures and policies were reviewed and evaluated by the auditor. Then, based on the data analysis performed and the auditors' judgment, audit opinions were made. There were some automated audit assist tools available. However, these were limited to audit retrieval software available for use on mainframe computers. These programs were used to manipulate and extract data from automated data bases. The advent of microcomputers has not changed the basic audit process. It has given auditors a new tool for performing these processes. The increased use of microcomputers for audit and audit management tasks was caused by several factors. These factors include the increased affordability of microcomputers, greater capabilities of the machines and the development of "user friendly" software programs for many different tasks.

The first microcomputers were introduced in the late 1970's. However, the growth in the use of microcomputers did not begin until the IBM Corporation introduced the IBM PC in 1981. These early machines were expensive and could only perform a limited number of functions. They were used mainly by scientists and data processing professionals. The software products available for these microcomputers were limited. However, in the last two years the microcomputer's capabilities have significantly expanded. At the same time the microcomputer's price has dropped sharply. Some examples of this price decrease are shown in Table 10.

The cost in 1981 prices for 1986's typically configured microcomputer would be approximately $8300. Today this microcomputer would cost about $2000 and perform better than earlier machines. [Ref. 55] This is one of the reasons why microcomputers have spread into businesses and audit organizations.

TABLE 10

PRICE COMPARISONS FOR MICROCOMPUTER COMPONENTS

Item	Prices 1981	1986
Monochrome Monitor	$345.00	$ 89.00
Disk Drive	$570.00	$ 85.00
Cost/Kilobyte of Memory	$ 8.35	$ 0.35
Display & Printer Card	$335.00	$150.00

[Ref. 55]

Another reason for the increased use of microcomputers is the availability of useful software. There has been a proliferation of new software products developed in the last two years. These products are suitable for all types of business and audit tasks. In addition, these programs are designed for use by people who are not data-processing professionals. The program commands are a combination of keystrokes and English words. The user controls what the program does, but not how the program performs its function. This makes it easier to learn and use these programs.

There are many benefits of using microcomputers in the audit process. These benefits include (1) increased reliability of audit results, (2) ability to sample more data, (3) standardization of audit procedures and presentations, and (4) better use of audit resources in planning, performing and managing audits. While the majority of auditors and audit managers recognize these benefits, there are differing opinions on how to achieve them. These differences include both the methods of using microcomputers and the audit areas that are suitable for microcomputers.

Audit organizations in private industry and the Federal government were surveyed on how they used microcomputers. The survey gathered data on microcomputer audit applications, software used, and who used the microcomputers. The data were analyzed for trends in microcomputer usage by auditors and audit managers. Also, the survey results were compared to data gathered from Naval Audit Service on microcomputer usage. From this comparison, potential microcomputer audit applications and methods of achieving them in Naval Audit Service were identified. In addition, published survey results on microcomputer use in audit organizations were reviewed for further data on microcomputer use.

B. SURVEY OF MICROCOMPUTER USE BY AUDITORS IN PRIVATE INDUSTRY AND THE FEDERAL GOVERNMENT

1. Background

A survey questionnaire was sent to public accounting firms, banks, other private industry audit organizations, and Federal government audit groups. This survey included background questions concerning the types of audits performed and audit procedures. The purpose of these questions was to determine the similarity of the respondents' audit work load to the Naval Audit Service's work load. Responses received from audit organizations with a similar work load would have more importance in the analysis of microcomputer use. The remaining questions concerned the use of microcomputers by the auditors and audit managers. These questions asked what audit applications were performed on microcomputers; what types of software was used by the organization, who was using the microcomputers, and where they were used. These questions identified potential areas of microcomputer use for the Naval Audit Service. Also, these questions identified the means of achieving these microcomputer applications. A final question asked the respondents to list other areas of microcomputer usage by auditors and audit management they felt should be considered in this thesis.

2. Methodology

Potential survey respondents were selected from a variety of companies and Federal agencies. The companies initially considered were involved in banking, public accounting, oil production, mining, manufacturing, food processing, and a variety of service industries. Initially, seventy-one companies were judgmentally selected on the basis of sales volume and number of employees. Thirty-eight companies responded to the initial contact letter and agreed to participate in the survey. The Federal audit organizations were in both Department of Defense (DoD) and non-DoD agencies. Five Federal audit organizations participated in the survey. A list of the survey participants is included in Appendix C. A copy of the questionnaire sent to these audit organizations is included in Appendix D. The purpose of the survey questions was to identify how other organizations used microcomputers. Information gathered in the survey could help the Naval Audit Service to better utilize and manage its microcomputers.

Percentages reported in the tables in the following sections are for all respondents who answered the question. Also, separate percentages are included for

Federal audit organizations. This was done to illustrate the extent of microcomputer use in other Federal agencies compared with the microcomputer use in the Naval Audit Service. Unless otherwise noted, multiple answers were acceptable for the survey questions.

3. **Results**

The audit organizations surveyed performed all types of audits. The percentage of organizations that performed each kind of audit are shown in Table 11.

TABLE 11

TYPES OF AUDITS PERFORMED BY RESPONDENTS

Audit Types	Percentage of Respondents	
	Total	Federal
Financial	93	60
Operational	91	100
Special Studies Requested by Management	88	80

The functional areas reviewed in operational audits were similar to those reviewed by the Naval Audit Service for most organizations. Table 12 lists the functional areas reviewed by the survey respondents. Standard audit program usage varied greatly among the respondents. This usage is one indication of the amount of repetition in an organization's audit work load. It is easier to develop microcomputer applications and increase microcomputer usage in an organization when the audit work load is repetitive. Table 13 details audit program usage by the survey respondents.

As discussed in Chapter 2, the Naval Audit Service has 44 standard audit programs for use by its auditors. However, 37% of the audit work load for fiscal year 1986 was non-recurring or special audits which require development of special audit programs. [Ref. 17] The results of these background questions indicated that the survey respondents work load and approach were similar to the Naval Audit Service's. Thus, the results from the specific questions about microcomputer usage are relevant to the Audit Service.

TABLE 12

FUNCTIONAL AREAS AUDITED IN OPERATIONAL AUDITS

Functional Areas	Percentage of Respondents	
	Total	Federal
Payroll	92	60
Supply/Inventory	90	60
Data Processing	87	80
Disbursement/Bill Paying	82	60
Fixed Assets	82	40
Contracting/Procurement	77	60
Cash Management	69	80
Personnel	67	60
Warehousing	64	40
Maintenance and Repair	62	60
Transportation	54	60
Manufacturing and Production	49	40
Timekeeping	49	40
Communication	41	60
Budgeting	36	40

TABLE 13

AUDIT PROGRAM USAGE BY SURVEY RESPONDENTS

	Percentage of Respondents	
	Total	Federal
In what percentage of audit applications are standard audit programs used?		
76% - 100%	37	0
51% - 75%	30	40
26% - 50%	16	20
1% - 25%	16	40
In what percentage of audit applications are unique audit programs developed?		
76% - 100%	16	20
51% - 75%	12	20
26% - 50%	26	40
1% - 25%	46	20

The next series of questions concerned what types of applications microcomputers were used for and the types of microcomputer software used to implement these applications. Respondents were given choices of common microcomputer applications for performing audit and administrative tasks. The choices included both simple applications such as report writing and more complex applications such as graphics and telecommunications. The number of these applications performed by the respondents varied from as few as one to all of the listed applications plus additional ones not listed. Table 14 shows the use percentages for these microcomputer applications.

TABLE 14
MICROCOMPUTER APPLICATIONS USED BY RESPONDENTS

Applications	Percentage of Respondents	
	Total	Federal
Report Writing	86	100
Electronic Workpapers	74	100
Data Analysis	74	80
Audit Management	70	80
Statistical Sampling	53	60
Telecommunication	49	100
Graphics	44	60
Audit Presentation	33	60
Other	19	0

The applications with higher usage percentages are the ones that are the easiest and most obvious to transfer from manual methods to the microcomputer. The remaining applications are more complex and require more experience with microcomputers to implement. There is a learning curve associated with microcomputer technology. After auditors and audit managers become more experienced microcomputer users, they develop audit applications for the microcomputer that are more complex in operation and purpose than previous microcomputer audit applications.

All of the respondents used commercial software products on their microcomputers. This is the quickest and most reliable method for non-data

processing professionals to utilize microcomputers. The software types and inventory of products used varied among the respondents. Virtually every organization used word processing and spreadsheet software either as a single program or part of an integrated software program. Also, data base programs were used by a majority of the organizations. The remaining software types were used by less than half of the respondents. The trends in software usage may be related to the complexity of microcomputer application. The software types used less frequently are developed for a specific problem or application. The majority of users are not sufficiently knowledgeable in using the microcomputer to perform this task or realize the need to perform it. See Table 15 for the types of software programs used by the respondents.

TABLE 15
SOFTWARE USED BY THE SURVEY RESPONDENTS

Software Type	Percentage of Respondents	
	Total	Federal
Spreadsheet	91	100
Word Processing	91	100
Data Base	65	80
Graphics	49	80
Telecommunications	44	100
Utilities	35	40
Integrated Packages	30	60
Project Management	26	60
Other	26	40
Statistics	23	60
Accounting	5	0

About 49% of the organizations developed custom audit programs using a high level programming language such as COBOL, BASIC, or PASCAL. These programs were used for downloading data from mainframe computers, performing random sampling, and budgeting, among other tasks. Development of an extensive library of custom programs is not a viable option for the Naval Audit Service at this time. The amount of work required to develop, test, and maintain these programs is significant. There are only a few computer specialists in the Naval Audit Service and their time and expertise is required for performing EDP audits.

In order for microcomputers to become fully integrated into an audit organization, all auditors and audit managers must use them. Also, the microcomputers must be available at the audit location and the audit office. Restrictions on microcomputer use may result in the isolation of microcomputers and their users from normal audit operations. The survey results on who uses microcomputers and where they are used indicate that most audit organizations are advocating microcomputer use by all their personnel and are providing the auditors and audit managers with portable microcomputers for use at the audit location as well as microcomputers for use in the audit office. Table 16 indicates who is using the microcomputers in the organizations surveyed. Table 17 indicates where the microcomputers are used.

Some of the additional issues raised by the survey respondents included the speed with which microcomputers are introduced into audit organizations and assimilated into the audit process, controls needed over microcomputer use and custody, importance of software and hardware compatibility, and use of microcomputers to communicate with mainframe computers. Discussions of these issues were incorporated into Chapter 2, except for microcomputer-to-mainframe communications. This issue was considered outside the scope of this thesis.

TABLE 16

MICROCOMPUTER USERS IN THE ORGANIZATION

Users	Percentage of Respondents	
	Total	Federal
All auditors	74	60
Audit Managers	35	60
Specially trained auditors	14	20
Some auditors	12	40
Technical specialists	12	60
EDP auditors only	7	0
Reviewers	2	20

TABLE 17
WHERE MICROCOMPUTERS ARE USED

Location	Percentage of Respondents	
	Total	Federal
Audit Office/ Headquarters	98	100
On-Site (Portables)	77	100

The extent of microcomputer use in these organizations indicates that microcomputers have become an increasingly valuable tool for performing audits. One of the organizations surveyed plans to start conducting fully electronic audits in the next year. While the Naval Audit Service is not at that stage of microcomputer integration, completely electronic audits are a long-range possibility.

C. SURVEY OF MICROCOMPUTER USE IN THE NAVAL AUDIT SERVICE

1. Background

A different survey questionnaire was sent to Naval Audit Service personnel who used microcomputers. The purpose of this survey was to determine how the microcomputers are currently used. This included what applications they were used for, what audit areas the application was used on, and if the application could be used again. Also, the survey identified problem areas encountered in using the microcomputers and opinions on how the microcomputers should be integrated into the Naval Audit Service. These data identified areas for thesis research and consideration. Also, they provided an indication of how microcomputer use is progressing in the Naval Audit Service.

2. Methodology

Survey questionnaires were sent to 27 audit sites that used microcomputers. All microcomputer users were asked to fill out the questionnaire. The number of auditors using the microcomputer varied by audit site. At some of the audit sites there were several microcomputer users who filled out the questionnaire. At other sites there was only one primary user. Responses were received from 18 auditors-in-charge and 33 auditors at the various sites.

Unless otherwise noted all percentages given in the survey results are for respondents who answered the question. In several cases questions were not answered because of the respondents lack of knowledge in the area. Also, for many of the questions, multiple answers were given by the respondents. A copy of the survey questionnaire is included in Appendix D.

3. **Results**

The length of time the microcomputer was in use at the audit sites ranged from between 3 to 6 months to over a year. The majority of the users did not have any previous experience in using microcomputers, although 24% of the respondents had their own microcomputers at home. Table 18 details the experience of the microcomputer users.

TABLE 18
PREVIOUS EXPERIENCE IN USING MICROCOMPUTERS

Previous Experience	Percentage of Respondents
None	59
Home (own a microcomputer)	24
Previous Job	16
College	12

Discussions with audit site personnel disclosed that there were generally one or two primary users of microcomputers. The remainder of the site audit staff either did not use the microcomputer or used it only for word processing tasks. Some of the problems encountered in using the microcomputer indicate why microcomputer use is not greater. Table 19 lists problems encountered by Naval Audit Service microcomputer users. The two biggest problems were lack of formal training and the time required to learn how to use the microcomputer. These problems are compounded by the fact that over half of the potential users have no prior experience with microcomputers. In addition, two other problems limit the use of microcomputers. These are hardware reliability and access to an available machine. These problems should abate as more, better quality microcomputers are purchased.

TABLE 19

PROBLEMS IDENTIFIED IN USING MICROCOMPUTERS

Problem	Percentage of Respondents
Time required to learn how to use	55
Lack of formal training	51
Access to a free machine	37
Hardware reliability	37
Developing the right application	24
Other	24
Poor software documentation	6

The applications for which microcomputers were used in the Naval Audit Service were similar to the microcomputer applications in private industry and other Federal audit organizations. However, the extent of usage is not as high in the Naval Audit Service as it is in private industry and other Federal audit organizations. Two of the possible reasons for this may be the inexperience of the Naval Audit Service users and the length of time microcomputers have been used at most of the audit sites. Table 20 shows the microcomputer applications used in the Naval Audit Service. The table breaks down this usage figure by length of time the microcomputers were available at the audit site. The results contained in Table 20 are inconclusive concerning increased use of microcomputer applications the longer the microcomputer is available. However, it does appear that complex applications are used more and a greater variety of applications are developed and performed.

One series of questions in the survey asked what specific functional areas, audit programs, and audit steps the microcomputers were used on. The results would help determine the feasibility of developing a data base of audit applications for a specific program and/or audit step. The results received were inconclusive for several reasons. Many of the respondents did not answer this question. Those who did answer the question either used the microcomputer for special audits or did not identify the applications in enough detail. A follow-on question asked whether these applications could be used again. The majority of applications could be reused. Table 21 shows the extent to which these applications can be reused.

TABLE 20

MICROCOMPUTER APPLICATIONS USED

Applications	Percentage of Respondents	
	Total	Micro over 1 year
Report Writing	82	72
Statistical Sampling	75	67
Data Analysis	65	61
Electronic Workpapers	39	44
Telecommunication	25	50
Audit Management	22	22
Graphics	22	33
Audit Presentation	14	22
Other	4	6

The results contained in Table 21 indicate that users are developing applications that are reusable on other audits. The Naval Audit Service should establish a central database for accumulating these applications. If the applications were published throughout the organization, possibly they could be used on other audits. Also, auditors may be able to modify the applications to perform other audit steps. Finally, the existing applications may assist the microcomputer users in developing new applications.

Publicizing audit applications is one way to facilitate the integration of microcomputers into the audit process. There are several other methods that could be used to achieve integration. One of the survey questions asked the user's opinion on how the Naval Audit Service should achieve integration of the microcomputers. None of the alternatives given in the question was preferred by a majority of the users. The comments included on some of the responses indicate a wide range of opinion on this question. Some users emphatically stated that Headquarters should not develop the applications. Others thought this was the best integration solution. Some respondents felt that audits and audited activities were too varied for standard audit applications to be useful. However, they did feel that standard applications for administrative tasks was a good idea. Some respondents felt that microcomputers should not be

TABLE 21

ABILITY TO REUSE MICROCOMPUTER APPLICATIONS

Ability to Reuse	Percentage of Respondents
Yes, the next time this audit is performed (same activity).	45
Yes, for audits of the same type of activity.	43
Yes, every time this audit program step is performed.	22
Unable to determine at this time.	14
No	2

used on all audits and that development of standard applications would force them to apply microcomputer technology where it was not appropriate. The best solution appears to be a combination of two alternatives. Develop standard applications for administrative tasks but allow the individual auditor to develop audit applications. Audit applications previously used on audits could be distributed organization-wide in conjunction with this alternative. Table 22 lists the results for this question.

The Naval Audit Service microcomputer users surveyed are realizing benefits from the microcomputers despite their inexperience and problems with using them. The benefits identified include better-looking output, ability to analyze more data, less time spent on repetitive tasks, and enhanced reliability in statistical sampling. Table 23 lists the benefits identified from using microcomputers. In addition, most of the respondents believe that the potential level of microcomputer use will eventually be high for both audit and administrative tasks. Table 24 lists the respondents opinions on potential level of microcomputer use.

TABLE 22

ALTERNATIVES FOR INTEGRATING MICROCOMPUTERS

Alternatives	Percentage of Respondents
Users should develop their own applications and distribute them to other auditors via a NAS computer newsletter or an electronic bulletin board.	37
Standard routine should be developed for repetitive administrative tasks but audit applications should be developed each time an audit is performed.	33
Headquarters should develop standard software applications for audit program steps and administrative tasks.	31
Other	24

TABLE 23

BENEFITS FROM USING MICROCOMPUTERS

Benefits	Percentage of Respondents
Less time spent on repetitive tasks	65
Better looking output	57
Enhanced reliability in statistical sampling	53
Ability to review larger amounts of data	51
Enhanced reliability of data analysis	33
Other	24

TABLE 24

POTENTIAL LEVEL OF MICROCOMPUTER USE

Audit Tasks	Percentage of Respondents
High	63
Medium	35
Low	2
Administrative Tasks	
High	88
Medium	12
Low	0

The majority of microcomputer users in the Naval Audit Service are just beginning to realize the microcomputer's potential for performing audit and administrative tasks. This was shown by the responses received to survey questions concerning applications the users wanted to do but could not and what other types of software the Naval Audit Service should purchase. On the majority of questionnaires these questions were left blank. Also, some respondents indicated they were too inexperienced in using microcomputers to know of any. Some of the respondents stated that they were not fully utilizing the software they already had available. This situation should change as the microcomputer users gain experience and receive additional training.

D. PUBLISHED SURVEY ON MICROCOMPUTER USE

A survey of microcomputer use, management and control was conducted by Price Waterhouse & Company for the National Association of Accountants in 1984. Participants in the survey covered a wide range of businesses that were geographically dispersed throughout the country and included both large and small companies. While the survey covered a number of topics that are not discussed in this thesis some of the survey results are useful for illustrating how microcomputers are used and raising issues concerning microcomputer use for accountants and auditors. These questions and survey results are included in Table 25. Consult the published document for a detailed discussion of the survey and its results.

Although only 20% of the survey respondents worked in the auditing area, the results of this survey are still pertinent to audit organizations that are using or contemplating using microcomputers. The respondents used microcomputers for a large number of applications. Since this survey was conducted, both the number of microcomputer applications and their level of use has probably increased. Particular applications that are useful for auditors include on-line access to records, mailing lists, electronic mail, and word processing. How these applications can be used in the audit process was discussed earlier in this thesis.

The questions on microcomputer policy, controls and training support the discussion contained in Chapter 2 of this thesis. The companies used a variety of methods to provide microcomputer users with necessary training. Microcomputer training was not discussed in detail in this thesis. However, survey results from the Naval Audit Service microcomputer users disclosed that training is an important consideration. The NAA survey results provide a list of training methods used by other companies. This information provides training alternatives to the Naval Audit Service.

The existence of a technical support group in the majority of companies is another important point. As previously discussed, this is one method for achieving integration of microcomputers into an audit organization. The methods and personnel used to implement the technical support group provides audit organizations with alternatives. [Ref. 10]

The questions concerning software development highlight some important considerations for audit organizations. Software development must be performed correctly to ensure that software products will meet desired goals and perform as expected. Software must be adequately tested and documented. Otherwise there is little assurance that the software program will produce the desired results. Also, if the software is not adequately documented it will be difficult to use and maintain. This will be especially true if the original developer leaves the organization.

The importance of internal controls over microcomputer hardware and software is recognized by all organizations. There are many ways to achieve adequate control over microcomputer hardware and software. Answers to the survey question illustrate a few of them. The important point is that these controls are developed, publicized throughout the organization and enforced. Microcomputer hardware and software can be a large investment for an organization. Also, auditors are using microcomputers to

perform more audit tasks. The negative impact, on auditor productivity and audit effectiveness, of loss or destruction of these assets will increase as microcomputers are used more in the audit process.

TABLE 25

NAA SURVEY RESULTS

Questions	Percentage of Respondents
In what applications are microcomputers being used in your company?	
Standalone accounting	52
Online access (read only) to accounting and other corporate records	28
Online data entry to accounting and other corporate records	18
Engineering/Research & Development accounting and other corporate records	24
Mailing Lists	36
Electronic Mail	25
Budgeting/Forecasting	81
Word Processing	69
Cash management	27
Telex	10
Timesharing	28
Has your company established management policies covering the use of microcomputers?	
Yes	57
No	43

TABLE 25

NAA SURVEY RESULTS (CONT'D.)

Has your company established a policy(ies) covering the acquisition of microcomputers and microcomputer software?	
Yes	83
No	17
Does your company provide training to microcomputer users?	
Yes	78
No	22
If yes, what types of training are used.	
Internal classes	63
External classes	35
Instructional materials and tutorials purchased from third parties	62
Instruction by experienced users within the company	75
Other	8
Does your company have a microcomputer technical group which assists users with problems?	
Yes	59
No	41

TABLE 25

NAA SURVEY RESULTS (CONT'D.)

If yes, what is the background of the member(s) of this group?	
Accounting	14
EDP	96
Other	18
If no, does your company have an arrangement with an outside vendor, consultant, etc. to provide assistance to users?	
Yes	35
No	65
Do users develop their own software?	
Yes	49
No	51
If yes, is there a requirement that software be tested by an authorized individual?	
Yes	32
No	68
And if yes, is there a requirement that such software be documented in accordance with established standards?	
Yes	32
No	68

TABLE 25

NAA SURVEY RESULTS (CONT'D.)

How is access to microcomputers, software, and applications controlled?	
Only authorized personnel are allowed to use particular machines	55
Locked rooms	29
Machine on/off switch is locked	6
Program and data diskettes are physically secured	58
Password protection at entry level	30
Manual and automated computer logs are required and monitored	8
Which of the following are used to ensure backup of your microcomputers and microcomputer software?	
Backup copies of all program disks are maintained in a central location away from all microcomputers	28
Backup copies of all programs are stored in a protected area	29
Backup copies of all program disks are maintained in the jacket provided with the program manual	29
Users are instructed to maintain backup copies of data files at regular intervals	75

TABLE 25

NAA SURVEY RESULTS (CONT'D.)

Do the microcomputers in your company communicate with other computers?	
Yes	61
No	39
With which of the following do your microcomputers communicate?	
Other microcomputers within the company	49
Minicomputers or mainframes within the company	76
Word processing equipment within the company	35
Computers external to the company (through external time sharing network)	57
In what area do you work?	
Finance/accounting	43
Data processing	33
Internal audit (EDP background)	8
Internal audit (accounting background)	11
Other	5

V. CONCLUSIONS

A. INTRODUCTION

The purpose of this thesis was to identify specific ways to use microcomputers in the Naval Audit Service. In particular, this thesis was concerned with how the microcomputer could increase the efficiency and the effectiveness of the auditors and audit managers in the Naval Audit Service.

First, this thesis discussed processes and policies for introducing microcomputers into the Naval Audit Service successfully. The Naval Audit Service workload was analyzed for areas in which microcomputers could be quickly assimilated into the audit process. A quick assimilation would provide a fast payback and ensure a niche for microcomputers within the Naval Audit Service. Next, off-the-shelf software was identified, reviewed and tested for possible use in audit applications. Finally, a survey was conducted to compare current microcomputer practices within audit organizations. The survey was conducted in audit departments in civilian industry, CPA firms, other federal government agencies and the Naval Audit Service.

B. SUMMARY AND RECOMMENDATIONS

1. The Process of Introducing and Integrating Microcomputers into the Audit Organization

Microcomputers are a new tool for the Naval Audit Service. As a new tool, the microcomputer represents change for the Audit Service. The planned program approach to introducing and integrating microcomputers into the audit organization is considered the most effective method to manage change. This presumes that the program is presented in a prioritized manner. Managing the change process effectively will significantly reduce the uncertainty associated with the change. Managers should consider the technical and political impact of the change when choosing courses of action to follow. The first aspect of the technical impact includes microcomputer support in the form of a technical resource person (who also understands auditing) available full-time to guide microcomputer users in applications of the microcomputer and to solve problems encountered in using the microcomputer. The second aspect of the technical impact is training. Managers should include microcomputer training as part of indoctrination for new personnel and also as part of continuing education for

auditors. The political impact of introducing microcomputers may necessitate organizational design changes to accomodate the new tool. Rules and procedures should be developed to ensure efficient and effective use of microcomputers and to allow for individual creativity and initiative in applying the new tool to daily work. An enforceable implementation plan should be developed and followed after the program strategy is chosen. As the implementation plan is followed, forces resisting the change to microcomputers can be overcome by support from top management, demonstrating a clear perception of the need for microcomputers, presenting a well-defined problem suitable for solution by microcomputer and seeking an early commitment from everyone in the organization.

a. Management Policies for Successful Implementation

The Department of Defense has issued mandatory guidance that should be considered as a minimum for successful implementation of microcomputers in the Naval Audit Service. Briefly, the Defense guidance calls for each agency to develop a plan for integrating computerized techniques into the audit process, a plan for effective and efficient use of current computer resources, effective controls and oversight to ensure reliability of computer equipment and work, protection of sensitive data, effective training in the use of microcomputers and documentation of the use of microcomputers during audits.

The microcomputer is useless by itself. It must have software and knowledgeable users to unlock its potential. Reliable software can be obtained by staying with proven products, insisting on user-friendly programs, reviewing references by present or past users of the software and thorough testing of the software before purchase. The objectives of microcomputer use should be to make the microcomputer an individual tool and to automate only if efficiency or effectiveness will be improved.

b. The Benefits and Constraints of Microcomputers

Microcomputers have the potential to increase office efficiency, improve operating methods, reduce physical effort, reduce the risk of overlooking material items and increase the audit organization's capacity to handle work volume. However, the auditor must also be cautious of the physical, operating and user constraints associated with this new tool. The auditor must adequately prepare for continuing the audit in the event that the microcomputer or any one of its functions is suddenly not available.

c. Microcomputers and the Naval Audit Service Workload

The workload analysis showed that the Naval Audit Service has a workload that is too diverse to develop standard microcomputer applications that would be applicable to a large portion of the workload. However, the workload analysis also disclosed that likely candidates for standardization of procedures exist at the continuous audit sites and in audits where similar functional areas are examined across different commands throughout the Navy and Marine Corps. In addition, the goal of standardization should be transportability of programs and procedures and the elimination of duplicate effort across the Naval Audit Service.

2. Software Applications and Audit Service Processes

There are hundreds of computer programs available. Sources include commercial vendors, public domain libraries and government agencies. In addition, there are differences in capabilities and intended uses within each category of software, such as between personal, professional and corporate word processors. Before purchase, software should be evaluated in terms of desired features, capabilities, cost and expected benefits.

3. Survey of Current Microcomputer Use by Audit Organizations

The audit organizations surveyed have started to realize the microcomputer's potential in performing audit tasks. This was shown by both the extent of microcomputer use and the number of different audit applications performed. The underlying trend in the survey data was one of microcomputer use by all auditors in the organization. The volume of applications varied but the majority of the respondents' microcomputer use was equal to, if not greater than, that in the Naval Audit Service. Generally, these applications were implemented by using commercial software products. However, almost half of the organizations developed their own custom software programs for specialized or unique applications. Almost all the survey respondents used both portable and desk-top microcomputers to implement these applications.

The National Association of Accountants' survey results detailed microcomputer applications that were performed in companies by both auditors and other employees. These applications can be used in the audit process and the daily operations of an audit organization. Also, this survey highlights microcomputer issues that audit organizations should consider. Adequate policies and controls over software and hardware assets are needed. The survey details some controls that are used. Also,

the survey results provide alternative training methods and ways of providing necessary training. Audit organizations should give microcomputer training a high priority, especially when the microcomputer users in the organizations are inexperienced.

The results from these two surveys support current microcomputer policy and usage in the Naval Audit Service. The Naval Audit Service has implemented control policies and procedures for its microcomputer hardware and software assets. The level of microcomputer usage in the Naval Audit Service is not as high as in the private industry and other federal government audit organizations surveyed. However, the microcomputer software used and the applications developed in the Naval Audit Service are similar to those of the survey respondents. Also, the Naval Audit Service practice of not restricting who can use the microcomputer is supported by the survey results in other audit organizations.

The private industry and federal government survey results point out one area of microcomputer usage and support that the Naval Audit Service should consider. The use of lap-top microcomputers for performing audits is one area. Currently, the microcomputers used in the Naval Audit Service are either luggable or desk top models. It is not practical to take these microcomputers from the audit site. The Naval Audit Service should consider purchasing a few lap-top microcomputers for performing audits at other than permanent audit sites. The need for truly portable computers will increase as auditors become more dependent upon them. Also, these microcomputers could be used at the audit site.

The NAA survey results on training and support of microcomputers is of interest to the Naval Audit Service because the majority of its microcomputer users are inexperienced. The survey results list alternatives to consider in these areas. The Naval Audit Service should conduct a further review of the costs and benefits of each of these alternatives. Then a microcomputer training and support plan could be developed to meet the users' needs.

The survey results from the Naval Audit Service microcomputers detail positive and negative results of using microcomputers. The overall attitude of users towards microcomputers is positive. Already, benefits have been realized from using the microcomputers. The overwhelming majority of users believe that the potential level of microcomputer use will be high for both audit and administrative tasks. However, the users are experiencing problems because of their inexperience in using microcomputers and a lack of formal training in microcomputer hardware and

software. Also, the users need a method for sharing applications developed for audit and administrative tasks. This will increase the use of microcomputers and expose more users to different applications. Naval Audit Service management can use these survey results to help plan the implementation and integration of microcomputers into the organization.

APPENDIX A
GLOSSARY

AIS - Automated Information System.

ASCII - American Standard Code of Information Interchange. Under this scheme, each character used by a computer is assigned a unique binary bit sequence that translates into decimal numbers from 0 to 255. Each unique bit sequence causes a unique character to be displayed or, in the case of non-displaying characters, recognized by and acted on by the computer.

BASIC - Beginners All-purpose Symbolic Instruction Code. A high-level computer language widely used to write programs for microcomputers. The BASIC interpreter translates each program instruction into machine-readable code on a line-by-line basis as the microcomputer executes the program.

BAUD - A unit of measure. The number of times that a transmission line changes state in one second. The speed of the transmission line is directly proportional to the baud rate.

CALDAY LOE - Calendar day, level of effort.

CPM - Control Program for Microcomputers. A program written to control the operation of microcomputers. Operating system programs, in general, free users from the need to understand complicated machine languages in order to accomplish coordination and control of the components that make up a microcomputer, such as the main memory, disk drives, tape drives, printer, display monitor and others. It is used on computers built by Apple, Commodore, and others.

DECISION SUPPORT SYSTEMS - (abbr. DSS) A DSS is a tool that aids, but does not replace, human judgement during the decision-making process. Some DSS operate using specific algorithms from the quantitative disciplines and others are based completely on heuristics. DSS are not required to be implemented through a computer, although they frequently are so implemented.

LINKED SPREADSHEET - A group of spreadsheets, stored as separate files, that are concurrently updated, automatically, whenever one or more of the linked spreadsheets in the group is updated.

MACRO - A list of keystrokes, normally executed by the user but imbedded within a file, which is executed by the computer so that the program runs as if the user had directed the program run sequence from the keyboard.

MODEM - Modulator, DEModulator. A device that converts the digital signals produced by the transmitting computer into analog signals for transmission over a telephone line, and re-converts the analog telephone signal into digital signals understood by the receiving computer.

MS-DOS - MicroSoft Disk Operating System. A program written by MicroSoft, Inc. to control the operation of the IBM personal computer. Operating system programs, in general, free users from the need to understand complicated machine languages in order to accomplish coordination and control of the components that make up a microcomputer, such as the main memory, disk drives, tape drives, printer, display monitor and others. It is also used on IBM-compatible computers built by Compaq, TeleVideo, Zenith, Sanyo, and others.

RAM - Random Access Memory. Volatile memory within a computer's main memory area (i.e., the computer's 'brain'). All information in RAM is lost when the computer is turned off.

SCREEN PAINTER - A computer program that develops data entry displays and menus.

TEMPEST CERTIFIED - Government certification that an electronic data manipulating device is authorized to handle classified information.

XMODEM - A method of transmitting digital data via a modem in which the data to be transmitted is divided into groups of data bits, called packets, before being transmitted. In addition to the user-related data, each packet contains control data, called overhead, that allows the modem and the microcomputer to recognize the beginning, ending, and loss of packets during transmission.

APPENDIX B
FIGURES FOR CHAPTER III

CLASSIFICATION:
Activity: Audit Nr:
Auditor: Reviewer:
Date prepared:
Period from: to:
Information source:
Audit scope:

Item Number	Contract Number	Price	Avail in Supply System?	Competed? (Yes = 1)	Number Bidders	Bid Period (days)	Sole Source? (Yes = 1)	Sole Src Justified?
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

Average price = % Competed =
Max price = % Sole Source =
Min price =

Figure 3.1 Sample Work Paper Template For Use During Contract Audits.

```
================================================================================
DISK:  X1098X   Double-Sided 9-sect 337K free   10-13-1986   00:05:11
================================================================================
 FILE NAME     SIZE     DATE     CATEGORY            DESCRIPTION
-----------  ------- --------  ----------  ---------------------------------
GENERAL .SEC     202  10/13/86  Cross-ref.  Audit workpapers to supporting docs
A_100   .WKS    1408  10/13/86  Spreadsht.  123 template for inventory audit
A_101   .WKS    1408  10/13/86  Spreadsht.  123 template for furniture audit
A_102   .WKS    1408  10/13/86  Spreadsht.  123 template for Plant & Equipment
A_103   .WKS    1408  10/13/86  Spreadsht.  123 template for vehicles audit
A_104   .WKS    1408  10/13/86  Spreadsht.  123 template for welfare & rec audi
SAMPLING.DES     218  10/13/86  Statistics  Descr of statistical samples taken
ASSIGNMT.LTR      63  10/13/86  Workpaper   Assignment letter
AUDIT   .PGM      91  10/13/86  Workpaper   Audit program
CHANGES .LST     110  10/13/86  Workpaper   List of AIC/AD major changes
CONFERNC.CLS      99  10/13/86  Workpaper   Closing conference record
CONFERNC.OPN     147  10/13/86  Workpaper   Opening conference record
CONTENTS.TBL     108  10/13/86  Workpaper   Workpapers' table of contents
FINAL   .DBF      52  10/13/86  Workpaper   Final debrief
FINAL   .RPT      45  10/13/86  Workpaper   Final audit report
FINDINGS.DFT     109  10/13/86  Workpaper   Draft findings
MISCREMA.RKS     112  10/13/86  Workpaper   Miscellaneous information
QC-CHECK.LST      95  10/13/86  Workpaper   Completed quality control checklist
REPORT  .GID      67  10/13/86  Workpaper   Completed audit report proc guide
SURVEY  .DBF      53  10/13/86  Workpaper   Initial survey debrief
```

Figure 3.2 DISKCAT Output Listings.

EXAMPLE OF A FINANCIAL PROFILE
OF THE
NAVAL DIVING AND SALVAGE TRAINING CENTER
AS OF 30 SEPTEMBER 1983

O&MN Funding Authorization (FY 1983)

Mission Operations	
Training Department	
Diving and Salvage	
Administration	
Travel	
Base Operations	
Audio Visual	
Purchasing	
Supply Support Hyperbarics	
Supply Support Ships	
Maintenance of Crafts	
Utilities	
General Engineering Support	
Telephones	
Vehicles	
Medical Department	
Civilian Labor	
Total	0

Status of Fund Authorization

Obligations	
Commitments	
Expenditures	
Total	0
Total Available Balance	0

Figure 3.3 Example Financial Profiles Using 1-2-3.

EXAMPLE OF AN OPERATIONS SUMMARY
OF THE
NAVAL DIVING AND SALVAGE TRAINING CENTER
AS OF 30 SEPTEMBER 1983

Personnel

	Military	Civilian
Current Allocation		
On Board		
Vacancies		
Departments	Authorized	On-board
Supply/Purchasing		
Comptroller		
Maintenance		
Medical		
Training		
Executive		
Totals	0	0

Supply

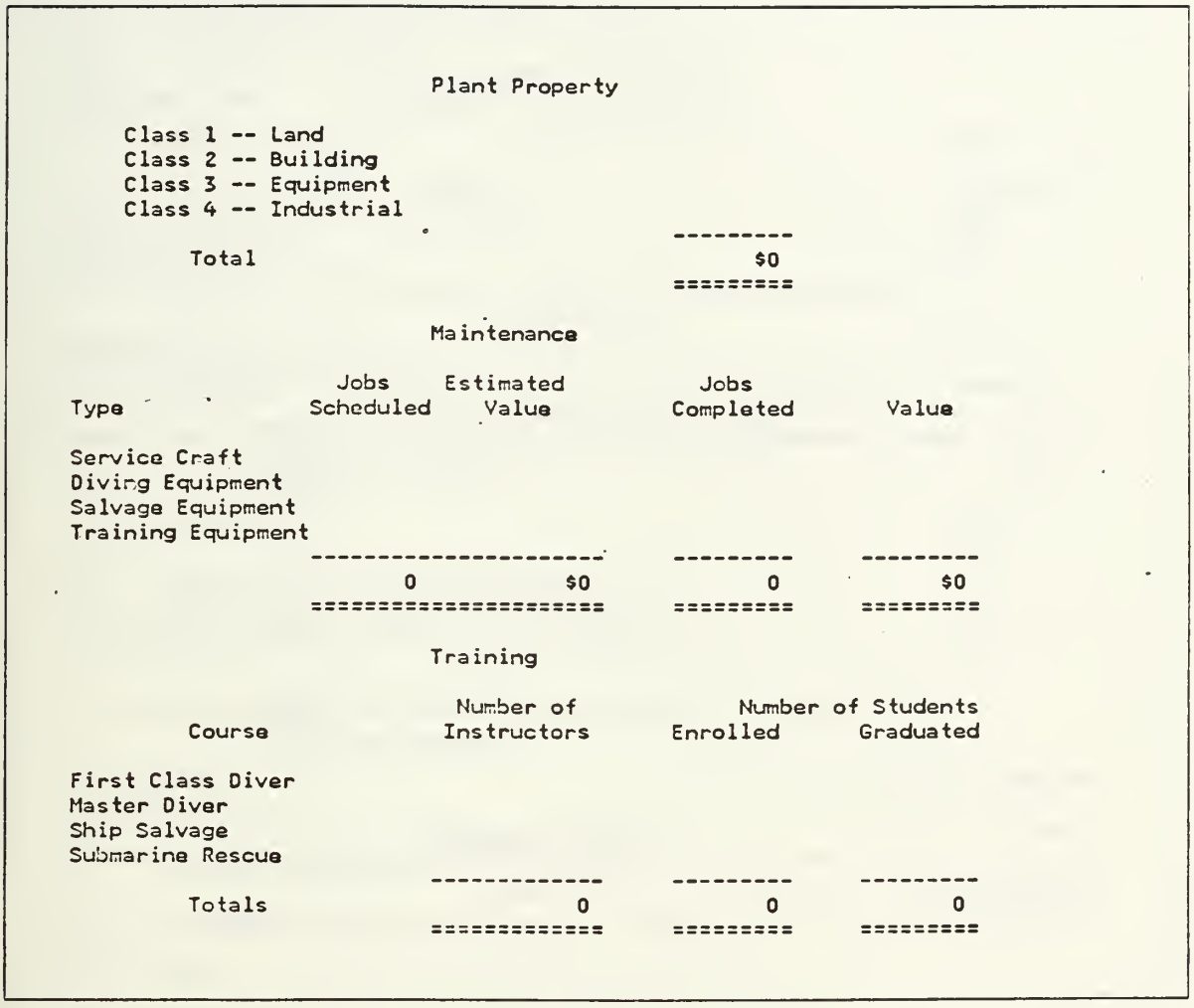
Average Number of Requisitions Processed Monthly	
Number of Line Items Stocked	
Value of Inventory	

Purchasing

	No.	Value
Service Contracts Awarded		
BPA Calls Placed		
Purchase Orders Issued		
Totals	0	$0

Purchase Action Categories	No.	Value
Competitive		
Non-Competitive		
Totals	0	$0

Figure 3.4 Example Operations Summary Using 1-2-3.



Plant Property

Class 1 -- Land
Class 2 -- Building
Class 3 -- Equipment
Class 4 -- Industrial

Total	$0

Maintenance

Type	Jobs Scheduled	Estimated Value	Jobs Completed	Value
Service Craft				
Diving Equipment				
Salvage Equipment				
Training Equipment				
	0	$0	0	$0

Training

Course	Number of Instructors	Number of Students Enrolled	Number of Students Graduated
First Class Diver			
Master Diver			
Ship Salvage			
Submarine Rescue			
Totals	0	0	0

Figure 3.4 Example Operations Summary Using 1-2-3. (cont'd.)

EXAMPLE OF A WORKSHEET FOR A
DISBURSING OFFICE CASH COUNT

U.S. Dollars:

Currency	Amount
100	
50	
20	
10	
5	
2	
1	
Other	
Total Currency	$0

Coin	
1.00	
.50	
.25	
.10	
.05	
.01	
Other	
Total Coin	$0.00

Foriegn Currency:

Country: ----------

Exchange Rate: ---------
(Foreign to U.S.
at Purchase)

Total Foreign: ----------

U.S. Equiv ----------

Figure 3.5 Example of 1-2-3 Used for Tallying Disbursing Officer Cash-On-Hand.

```
IFPSLOD: Begin run from DSS IFPSDSS:.
INTERACTIVE FINANCIAL PLANNING SYSTEM - 10.0 V3
READY FOR EXECUTIVE COMMAND
MODEL
ENTER MODEL NAME
ANALYZE1
BEGIN ENTERING NEW MODEL

COLUMNS 1986,1987,1988,1989,1990
ANNUAL SALES VOLUME INCREASE = 1.15
INFLATION = 1.08
MANUFACTURING COST YR1 = .19
MANUFACTURING COST = MANUFACTURING COST YR1,PREVIOUS MANUFACTURING
                                    COST*INFLATION
DISTRIBUTOR PRICE YR1 = .32
ANNUAL DISTRIBUTOR PRICE INCREASE = 1.05
DISTRIBUTOR PRICE = DISTRIBUTOR PRICE YR1,PREVIOUS DISTRIBUTOR PRICE * ANNUAL
                                 DISTRIBUTOR PRICE INCREASE
QUANTITY SOLD = 1300000, PREVIOUS QUANTITY SOLD * ANNUAL SALES VOLUME INCREASE
  *
  *
  * OPERATING REVENUE
  *
  *
SALES = QUANTITY SOLD * DISTRIBUTOR PRICE
COST OF SALES = QUANTITY SOLD * MANUFACTURING COST
NET OPERATING PROFIT = SALES - COST OF SALES
  *
  *
NET OPERATING MARGIN = NET OPERATING PROFIT/SALES
  *
  *
  * EXPENSES
  *
  *
OVERHEAD = 42000, PREVIOUS OVERHEAD * INFLATION
  *
  *
BEFORE TAX PROFIT = NET OPERATING PROFIT - OVERHEAD
  *
END OF MODEL
```

Figure 3.6 Sample Session Using a Financial Modeling Program.

```
SOLVE
MODEL ANALYZE1  VERSION OF  09/17/86  18:49 -- 5 COLUMNS 14 VARIABLES
ENTER SOLVE OPTIONS
ALL
                              1986      1987      1988      1989      1990

ANNUAL SALES VOLUME INCR     1.150     1.150     1.150     1.150     1.150
INFLATION                    1.080     1.080     1.080     1.080     1.080
MANUFACTURING COST YR1       .1900
MANUFACTURING COST           .1900     .2052     .2216     .2393     .2585
DISTRIBUTOR PRICE YR1        .3200
ANNUAL DISTRIBUTOR PRICE     1.050     1.050     1.050     1.050     1.050
DISTRIBUTOR PRICE            .3200     .3360     .3528     .3704     .3890
QUANTITY SOLD              1300000   1495000   1719250   1977138   2273708

  OPERATING REVENUE

SALES                       416000    502320    606551    732411    884386
COST OF SALES               247000    306774    381013    473219    587737
NET OPERATING PROFIT        169000    195546    225538    259192    296649

NET OPERATING MARGIN         .4063     .3893     .3718     .3539     .3354
  EXPENSES

OVERHEAD                     42000     45360     48989     52908     57141

BEFORE TAX PROFIT           127000    150186    176549    206284    239508
```

Figure 3.6 Sample Session Using a Financial Modeling Program. (cont'd.)

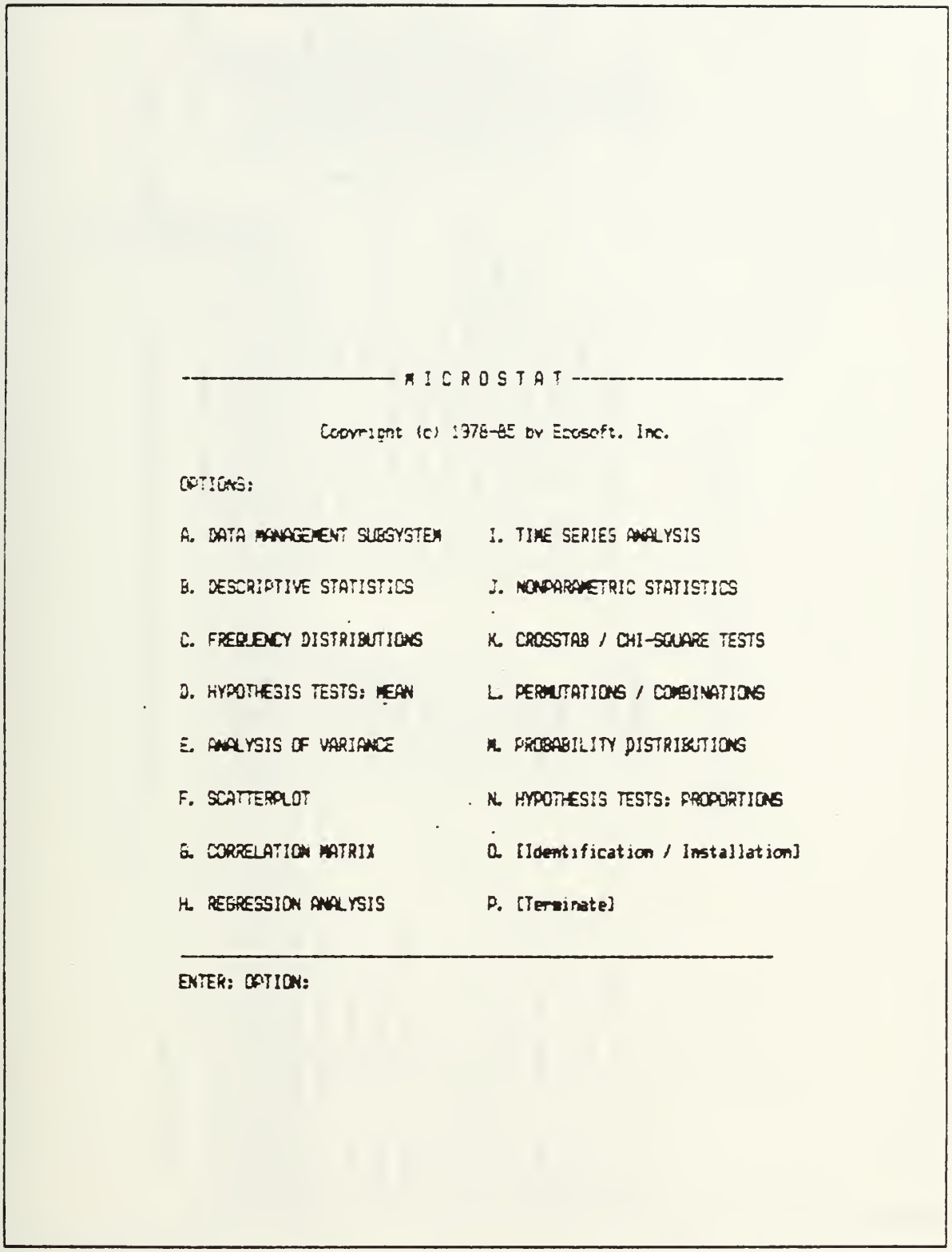
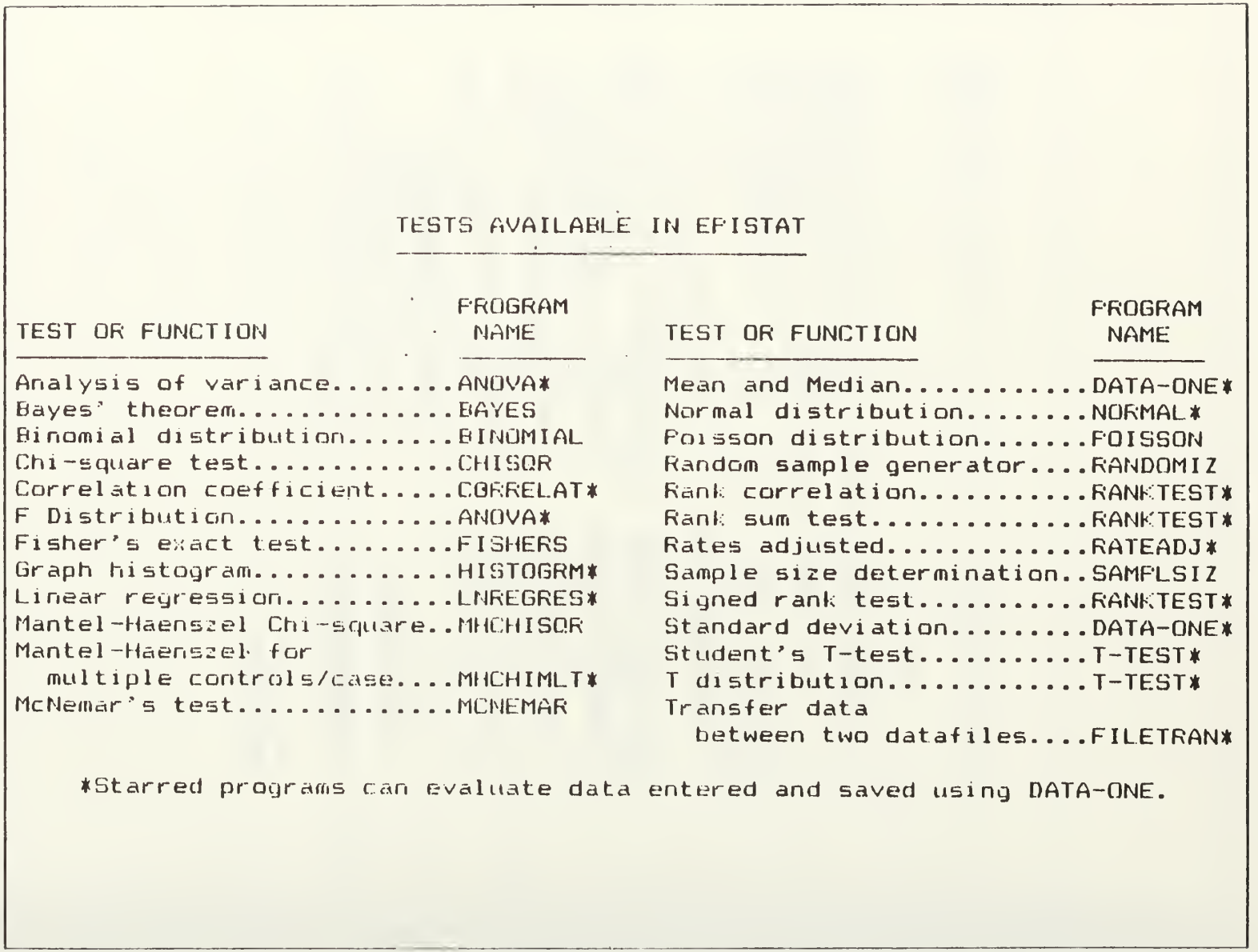


Figure 3.7 Microstat Main Menu.



TESTS AVAILABLE IN EPISTAT

TEST OR FUNCTION	PROGRAM NAME	TEST OR FUNCTION	PROGRAM NAME
Analysis of variance.....	ANOVA*	Mean and Median.....	DATA-ONE*
Bayes' theorem.....	BAYES	Normal distribution.....	NORMAL*
Binomial distribution.....	BINOMIAL	Poisson distribution.....	POISSON
Chi-square test.....	CHISQR	Random sample generator....	RANDOMIZ
Correlation coefficient.....	CORRELAT*	Rank correlation.....	RANKTEST*
F Distribution.....	ANOVA*	Rank sum test.....	RANKTEST*
Fisher's exact test.....	FISHERS	Rates adjusted.....	RATEADJ*
Graph histogram.....	HISTOGRM*	Sample size determination..	SAMPLSIZ
Linear regression.....	LNREGRES*	Signed rank test.....	RANKTEST*
Mantel-Haenszel Chi-square..	MHCHISQR	Standard deviation.....	DATA-ONE*
Mantel-Haenszel for multiple controls/case....	MHCHIMLT*	Student's T-test.....	T-TEST*
McNemar's test.....	MCNEMAR	T distribution.....	T-TEST*
		Transfer data between two datafiles....	FILETRAN*

*Starred programs can evaluate data entered and saved using DATA-ONE.

Figure 3.8 EPISTAT Program Modules.

11,000,000	POPULATION BOOK VALUE
0.95	CONFIDENCE LEVEL
2	EXPECTED OR ACTUAL NUMBER OF ERRORS
0.05	MATERIALITY RATE
550,000	MAXIMUM TOLERABLE ERROR
127	SAMPLE SIZE

RANDOM NUMBERS (DOLLAR UNITS TO AUDIT)
53,000
258,242
364,877
393,101
435,598
476,306
496,854
560,127
818,427
841,915
876,787
976,851
1,050,277
1,108,111
1,122,315
1,194,019
1,217,134
1,354,386
1,406,650
1,583,243
1,621,334
1,734,804
1,809,429
1,864,282
1,892,681
1,907,495
2,021,551
2,130,782
2,141,261
2,247,925
2,260,223
2,444,718
2,513,508
2,575,804
2,726,162
2,909,829
2,931,022
2,974,575
3,038,519
3,044,902
3,067,390
3,096,549
3,456,834
3,536,603
3,629,933
3,669,333
3,749,431
3,876,745
3,899,288
3,975,910

Figure 3.9 1-2-3 Template for Random Dollar-Unit Samples.

95% UPPER CONFIDENCE BOUND FOR MEAN ERROR: 2.054%

DOLLAR AMOUNT OF UPPER BOUND: $225,919.81

99% UPPER CONFIDENCE BOUND FOR MEAN ERROR: 3.046%

DOLLAR AMOUNT OF UPPER BOUND: $335,017.69

Figure 3.10 Upper Confidence Bound for Mean Sample Error.

HISTORICAL DATA

(Y) % INVENTORY RECORD VALIDITY	(X1) $ VALUE INVENTORY	(X2) # LINE ITEMS INVENTORY	(Y) % VALIDITY ESTIMATE
89.30	11,000,000	50,000	90.41
92.00	9,000,000	45,000	91.51
93.40	7,500,000	30,000	93.79
88.00	13,500,000	55,000	89.20
88.15	15,000,000	62,000	87.96
94.00	5,000,000	38,000	93.32
89.00	17,500,000	66,000	86.87
96.00	6,000,000	20,000	95.42
83.00	18,750,000	70,000	86.07
85.75	22,000,000	80,000	84.04

Regression Output:

Constant	99.36543	
Std Err of Y Est	1.722792	
R Squared	0.855056	
No. of Observations	10	
Degrees of Freedom	7	
X Coefficient(s)	-0.000000226	-0.00012
Std Err of Coef.	0.000000324	0.000099

Figure 3.11 Data and Regression Output for Inventory Sample.

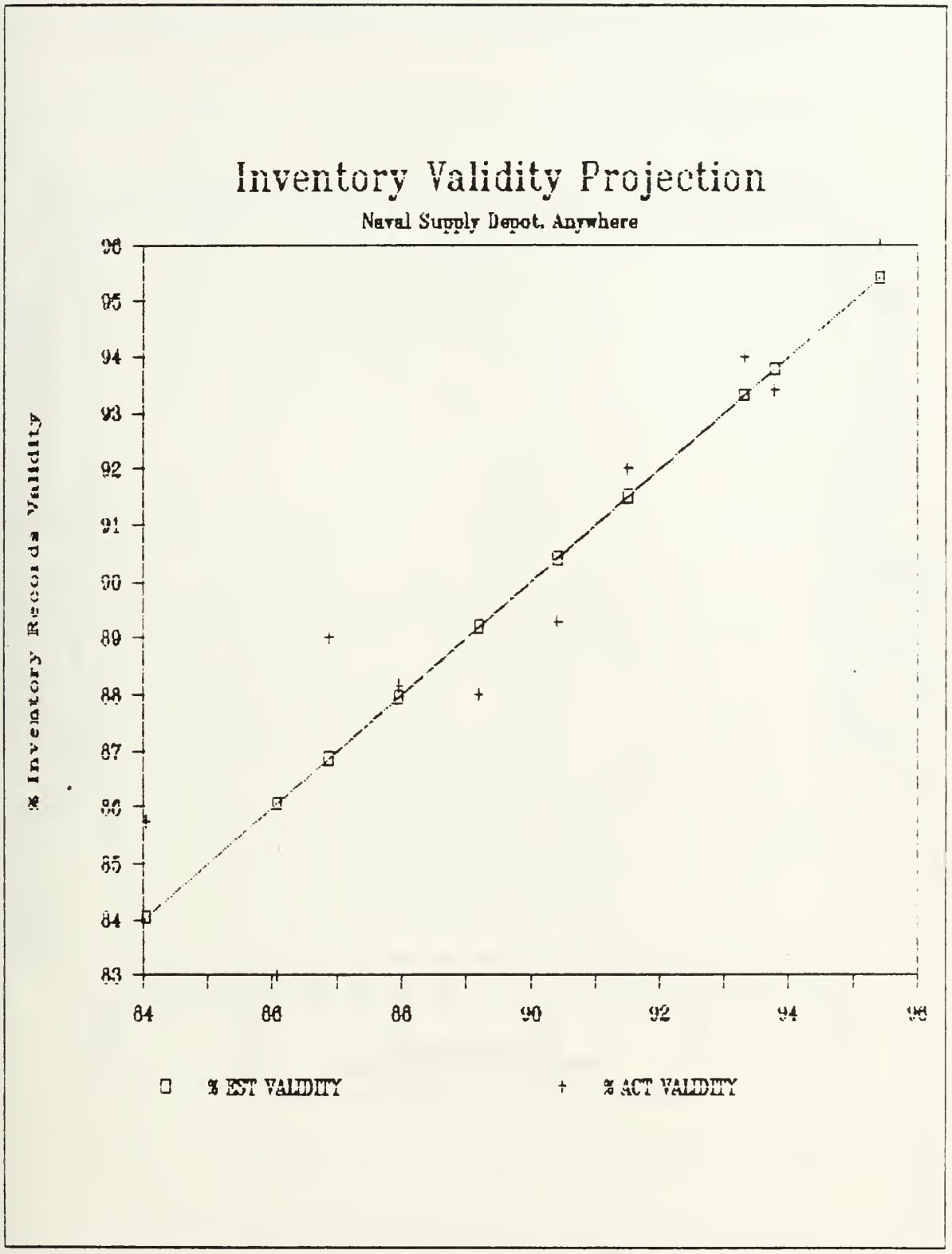


Figure 3.12 Inventory Validity Regression.

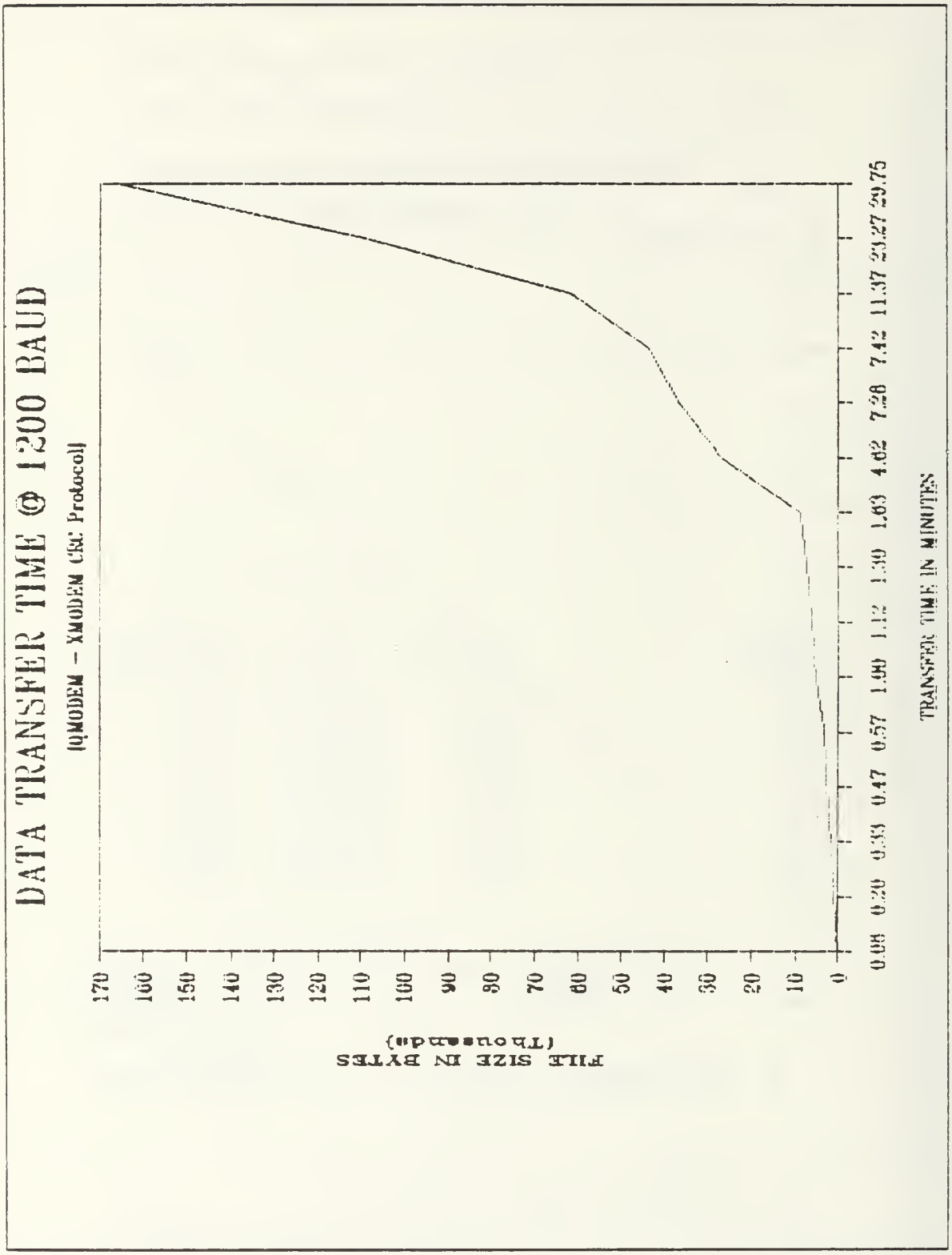


Figure 3.13 File Size vs Transfer Time.

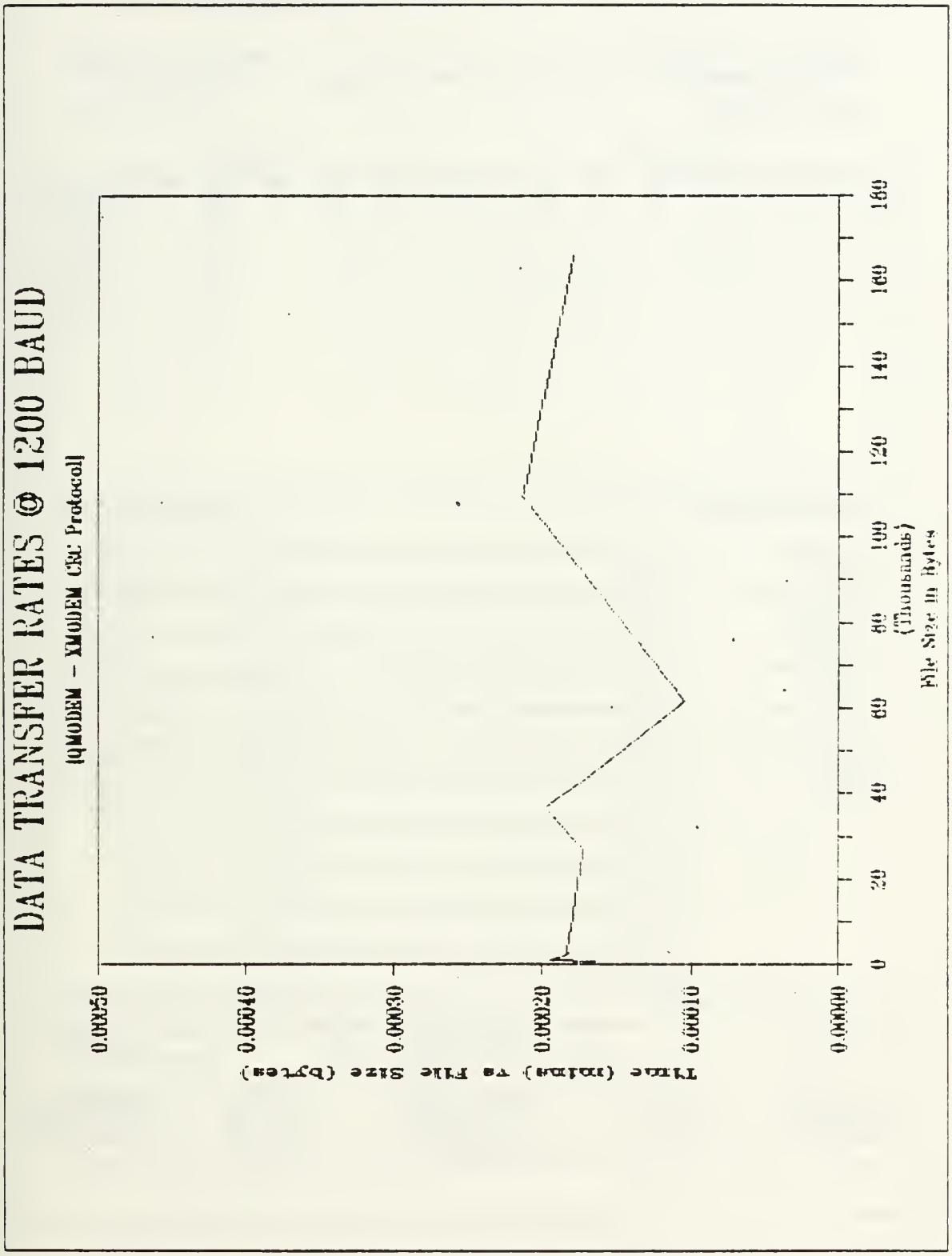


Figure 3.14 Comparison Ratio of File Size to Transfer Time.

```
BIWEEKLY TIME REPORT
NAVAUDSVC 5220.1                          PERIOD ENDING:

DIRECT MANHOURS:

              W/M LEAD
  AUDIT NO.   CODE AUD.  MON  TUE  WED  THU  FRI  MON  TUE  WED  THU  FRI  TOTAL
                                                                              0
                                                                              0
                                                                              0
                                                                              0
                                                                              0
                                                                              0
                                                                              0
                                                                              0
                                                                              0
                                                                              0
                                                                              0
                                                                              0
                                                                              0
                                                                              0
                                                                              0
 ------------------------------------------------------------------------     0
INDIRECT MANHOURS:                                ////////////////////////    0
                                                                              0
Training            ////////////////////////////////////////////////////////    0
Y_001__             /////                                                      0
Ind. Travel         ////////////////////////////////////////////////////////    0
Y_002__             /////                                                      0
Mgt/Admin           ////////////////////////////////////////////////////////    0
Y_003__             /////                                                      0
Tech.Func.          ////////////////////////////////////////////////////////    0
Y_004__             /////                                                      0
Leave & Hol.        ////////////////////////////////////////////////////////    0
Y_005___            /////                                                      0
Leave & Hol.        ////////////////////////////////////////////////////////    0
Y_005__             /////                                                      0
Other               ////////////////////////////////////////////////////////    0
Y_006__             /////                                                      0
                    ////////////////////////////////////////////////////////    0
                    /////                                                      0
                    ////////////////////////////////////////////////////////    0
                    /////                                                      0
                    ////////////////////////////////////////////////////////    0
                    /////                                                      0
                    ////////////////////////////////////////////////////////    0
                    /////                                                      0
                    /////-------------------------------------------------------
TOTAL DIRECT & INDIRECT   0    0    0    0    0    0    0    0    0    0       0
                          ==========================================================
NAME                                GRADE/RANK      SSN                 REGION
                                   |              |                  |              |
 ------------------------------------------------------------------------------
SIGNATURE:                         | PERS CATEGORY        1 AUDITOR      4 MGT SUPPORT
 ---------------------------------(enter "1" in          2 AUD MGT      5 ADMIN SUPT
APRROVED BY:                       | category)            3 CONSULT
 ------------------------------------------------------------------------------
```

Figure 3.15 NAVAUDSVC Form 5220.1 Incorporated Into a Lotus 1-2-3 Spreadsheet.

BIWEEKLY TIME REPORT
NAVAUDSVC 5220.1 PERIOD ENDING: 30 JUNE 1986

DIRECT MANHOURS:

AUDIT NO.	W/M LEAD AUD. CODE	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	TOTAL
X1098L	04	8	8	8	4	0	0	0	0	0	0	28
X1098L	05	0	0	0	4	8	8	8	2	0	0	30
X1098L	06	0	0	0	0	0	0	0	4	0	0	4
X1098L	07	0	0	0	0	0	0	0	2	0	0	2
X1098L	14	0	0	0	0	0	0	0	0	6	0	6
X1098L	17	0	0	0	0	0	0	0	0	1	0	1
X1098L	18	0	0	0	0	0	0	0	0	1	4	5
												0
												0
												0
												0
												0
												0
												0
												0
INDIRECT MANHOURS:												0
												0
Training												0
Y_001__												0
Ind. Travel												0
Y_002__												0
Mgt/Admin												0
Y_003__												0
Tech.Func.												0
Y_004__												0
Leave & Hol.												0
Y000576												0
Leave & Hol.												0
Y_005__												0
Other												0
Y_006__												0
												0
												0
												0
												0
												0
												0
												0
TOTAL DIRECT & INDIRECT		8	8	8	8	8	8	8	8	8	4	76

NAME	GRADE/RANK	SSN	REGION
JOHN Q. AUDITOR	GS-12	123-45-6789	HQ

SIGNATURE:

APRROVED BY:

PERS CATEGORY (enter "1" in category)
1 1 AUDITOR
1 2 AUD MGT
3 CONSULT
4 MGT SUPPORT
5 ADMIN SUPT

Figure 3.16 Sample Individual Time Report #1.

BIWEEKLY TIME REPORT
NAVAUDSVC 5220.1 PERIOD ENDING: 30 JUNE 1986

DIRECT MANHOURS:

AUDIT NO.	W/M CODE	LEAD AUD.	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	TOTAL
X1098L	15A		3	0	0	4	0	0	0	0	0	0	7
X1098L	15B		0	4	0	4	0	0	0	2	0	0	10
X1098L	15C		2	0	0	0	3	0	0	4	0	0	9
X1098L	15H		0	2	0	0	5	0	0	2	0	0	9
X1098L	15M		1	0	8	0	0	0	0	0	6	0	15
X1098L	15P		0	0	0	0	0	8	8	0	1	0	17
X1098L	15Q		0	0	0	0	0	0	0	0	1	0	1
													0
													0
													0
													0
													0
													0
													0
													0
INDIRECT MANHOURS:													0
													0
Training													0
Y_001__													0
Ind. Travel													0
Y_002__													0
Mgt/Admin													0
Y000351													2
Tech.Func.													0
Y000461													8
Leave & Hol.													0
Y_005__													0
Leave & Hol.													0
Y_005__													0
Other													0
Y000692													2
													0
													0
													0
													0
													0
													0
													0
													0
TOTAL DIRECT & INDIRECT			8	8	8	8	8	8	8	8	8	8	80

NAME	GRADE/RANK	SSN	REGION
ROSE M. ACCOUNTANT	GS-13	345-76-3452	HQ

SIGNATURE:

APRROVED BY:

PERS CATEGORY (enter "1" in category)
1 1 AUDITOR
1 2 AUD MGT
3 CONSULT
4 MGT SUPPORT
5 ADMIN SUPT

Figure 3.17 Sample Individual Time Report #2.

BIWEEKLY TIME REPORT
NAVAUDSVC 5220.1 PERIOD ENDING: 30 JUNE 1986

DIRECT MANHOURS:

AUDIT NO.	W/M CODE	LEAD AUD.	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	TOTAL
X1098L	04		6	4	8	4	0	0	0	0	0	0	22
X1098L	05		0	0	0	3	5	7	7	1	0	0	23
X1098L	06		0	0	0	0	0	0	0	6	0	0	6
X1098L	07		0	0	0	0	0	0	0	1	0	0	1
X1098L	16		0	0	0	0	0	0	0	0	6	0	6
X1098L	23		0	0	0	0	0	0	0	0	1	6	7
X1098L	34		0	0	0	0	0	0	0	0	1	1	2
X1102A	01A		1	0	0	0	0	0	0	0	0	0	1
X1102A	02C		0	3	0	0	0	0	0	0	0	0	3
X1102A	03A		1	1	0	1	3	0	0	0	0	0	6
X1102A	03C		0	0	0	0	0	1	1	0	0	1	3
													0
													0
													0
													0
													0

INDIRECT MANHOURS: ////////////////////////// 0

Training	//											0
Y_001__	/////											0
Ind. Travel	//											0
Y_002__	/////											0
Mgt/Admin	//											0
Y_003__	/////	2										0
Tech.Func.	//											0
Y_004__	/////	2									6	0
Leave & Hol.	//											0
Y000576	/////											0
Leave & Hol.	//											0
Y_005__	/////											0
Other	//											0
Y_006__	/////										2	0
	//											0
	/////											0
	//											0
	/////											0
	//											0
	/////											0
	//											0
	/////											0
	/////											

TOTAL DIRECT & INDIRECT	8	8	8	8	8	8	8	8	8	8	80

NAME | GRADE/RANK | SSN | REGION
MARK I. TRAINEE | GS-9 | 345-86-9034 | HQ

SIGNATURE:
APRROVED BY:

PERS CATEGORY (enter "1" in category)
1 AUDITOR
2 AUD MGT
3 CONSULT
4 MGT SUPPORT
5 ADMIN SUPT

Figure 3.18 Sample Individual Time Report #3.

```
{GOTO}Q53{return}
/DSRD.{RIGHT}{RIGHT}{RIGHT}{END}{RIGHT}{END}{DOWN}{return}P{RIGHT}{return}D
{return}G{GOTO}R53{return}
/C{return}VAL1{return}{DOWN}
/C{return}VAL2{return}
/XI@EXACT(VAL2,"          "){return}/XGA23{return}
/XI@EXACT(VAL1,VAL2){return}{DOWN}/XGA10{return}
/WIR{DOWN}{DOWN}{return}{RIGHT}{RIGHT}
{BACKSLASH}-{return}{LEFT}{DOWN}STOTL{return}
{LEFT}{UP}{UP}/C{return}{DOWN}{DOWN}{return}{RIGHT}{DOWN}{DOWN}
{RIGHT}@SUM({UP}{END}{UP}.{END}{DOWN}{UP}{return}){return}
{UP}/C{DOWN}{return}.{RIGHT}{RIGHT}{RIGHT}{RIGHT}
{RIGHT}{RIGHT}{RIGHT}{RIGHT}{RIGHT}{return}
{DOWN}{DOWN}{DOWN}{LEFT}{LEFT}
/C{return}VAL1{return}
/XI@EXACT(VAL1,"          "){return}/XGA23{return}
{DOWN}/XGA10{return}
{RIGHT}{RIGHT}{BACKSLASH}-{return}{LEFT}{DOWN}STOTL{return}
{LEFT}{UP}{UP}/C{return}{DOWN}{DOWN}{return}{RIGHT}{DOWN}{DOWN}
{RIGHT}@SUM({UP}{END}{UP}.{END}{DOWN}{UP}{return}){return}
{UP}/C{DOWN}{return}.{RIGHT}{RIGHT}{RIGHT}{RIGHT}
{RIGHT}{RIGHT}{RIGHT}{RIGHT}{RIGHT}{return}
{DOWN}{LEFT}/C{return}VAL1{return}
/XI@EXACT(VAL1,"STOTL"){return}/XGA31{return}

/XI@EXACT(VAL1,"          "){return}/XGA36{return}
{LEFT}/RV.{END}{RIGHT}{return}{LEFT}{LEFT}{END}{DOWN}{END}{LEFT}{RIGHT}
{END}{UP}{DOWN}{return}{RIGHT}{END}{UP}
/C{return}VAL1{return}
/XI@EXACT(VAL1,"STOTL"){return}/XGA31{return}
{LEFT}{LEFT}{LEFT}{END}{DOWN}{END}{LEFT}{RIGHT}{END}{UP}
{DOWN}{RIGHT}TOTAL{return}
{RIGHT}@SUM({UP}.{END}{UP}{DOWN}{return}){return}
/C{return}.{RIGHT}{RIGHT}{RIGHT}{RIGHT}
{RIGHT}{RIGHT}{RIGHT}{RIGHT}{RIGHT}{return}
{END}{RIGHT}{RIGHT}
@SUM({LEFT}.{END}{LEFT}{RIGHT}{return}){return}
/C{return}{UP}.{END}{UP}{DOWN}{return}
{CALC}

CONSOLIDATED TIME REPORT                OFFICE:
NAVAUDSVC 5220.1                        PERIOD ENDING:

DIRECT MANHOURS (BY W/M CODE):

              W/M
  AUDIT NO.   STOTL  *   MON  TUE  WED  THU  FRI  MON  TUE  WED  THU  FRI  TOTAL
```

Figure 3.19 Blank Consolidated Time Report Showing the Macro.

CONSOLIDATED TIME REPORT OFFICE: HEADQUARTERS
NAVAUDSVC 5220.1 PERIOD ENDING: 30 JUNE 1986

DIRECT MANHOURS (BY W/M CODE):

AUDIT NO.	W/M STOTL	*	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	TOTAL
	01A	STOTL	1	0	0	0	0	0	0	0	0	0	1
	02C	STOTL	0	3	0	0	0	0	0	0	0	0	3
	03A	STOTL	1	1	0	1	3	0	0	0	0	0	6
	03C	STOTL	0	0	0	0	0	1	1	0	0	1	3
	04	STOTL	14	12	16	8	0	0	0	0	0	0	50
	05	STOTL	0	0	0	7	13	15	15	3	0	0	53
	06	STOTL	0	0	0	0	0	0	0	10	0	0	10
	07	STOTL	0	0	0	0	0	0	0	3	0	0	3
	14	STOTL	0	0	0	0	0	0	0	0	6	0	6
	15A	STOTL	3	0	0	4	0	0	0	0	0	0	7
	15B	STOTL	0	4	0	4	0	0	0	2	0	0	10
	15C	STOTL	2	0	0	0	3	0	0	4	0	0	9
	15H	STOTL	0	2	0	0	5	0	0	2	0	0	9
	15M	STOTL	1	0	8	0	0	0	0	0	6	0	15
	15P	STOTL	0	0	0	0	0	8	8	0	1	0	17
	15Q	STOTL	0	0	0	0	0	0	0	0	1	0	1
	16	STOTL	0	0	0	0	0	0	0	0	6	0	6
	17	STOTL	0	0	0	0	0	0	0	0	1	0	1
	18	STOTL	0	0	0	0	0	0	0	0	1	4	5
	23	STOTL	0	0	0	0	0	0	0	0	1	6	7
	34	STOTL	0	0	0	0	0	0	0	0	1	1	2
		TOTAL	22	22	24	24	24	24	24	24	24	12	224

Figure 3.20 Consolidated Time Report Showing Aggregate Data.

1. Obtain background information useful in planning and conducting the audit. This type information can be acquired from sources such as activity organizational manuals, command briefings, reports submitted to higher authority, and interviews.

2. Review all reports of audits, examinations, inspections, and surveys by GAO, NAVAUDSVC, NAVINSGEN, and other activities since the last internal audit; determine trends, problems, and corrective actions proposed; appraise the adequacy of the actions proposed; i.e., does it appear the problem will be resolved? (When reporting a continuing deficiency in the current report, reference may be made to the other reports, except that Navy Command Inspection Reports will not be referenced as the information contained therein is privileged internal Navy communication and releasable only upon authorization of the Inspection General).

3. Interview cognizant personnel of the activity and, if appropriate, associated with the activity (e.g., project offices and seniors in the chain of command) to ascertain their concerns and how the audit could be the most useful.

Figure 3.21 Original Document Before Revision.

1. Obtain background information useful in planning, and controlling the audit. This type information can be acquired from sources such as activity organizational manuals, command briefings, reports submitted to headquarters, and interviews.

2. Review all reports of audits, examinations, inspections, and surveys by GAO, NAVAUDSVC, NAVINSGEN, and other activities since the last internal audit. Determine trends, problems, and corrective actions proposed; appraise the adequacy of the actions proposed; i.e., does it appear the problem will be resolved? (When reporting a continuing deficiency in the current report, reference may be made to the other reports except that Navy Command Inspection Reports will not be referenced as the information contained therein is privileged internal Navy communication and releasable only upon authorization of the Inspector General).

3. Interview cognizant personnel of the activity and, if appropriate, associated with the activity (e.g., project offices and seniors in the chain of command) to ascertain their concerns and how the audit could be the most useful.

Figure 3.22 Original Document After Revision.

```
----------before
1.  Obtain background information useful in planning and
conducting the audit.  This type information can be acquired from
sources such as activity organizational manuals, command
briefings, reports submitted to higher authority, and interviews.

----------after
1.  Obtain background information useful in planning, and
controlling the audit.  This type information can be acquired from
sources such as activity organizational manuals, command
briefings, reports submitted to headquarters, and interviews.

-----------------------------------------------

----------before
 the last internal audit; determine trends, problems, and
corrective actions proposed; appraise the adequacy of the actions

----------after
the last internal audit. Determine trends, problems, and
corrective actions proposed; appraise the adequacy of the actions

-----------------------------------------------

----------before
reference may be made to the other reports, except that Navy
Command Inspection Reports will not be referenced as the

----------after
reference may be made to the other reports except that Navy
Command Inspection Reports will not be referenced as the

-----------------------------------------------

----------before
Inspection General).


----------after
Inspector General).

-----------------------------------------------

----------before
```

Figure 3.23 Output From FILECOMP.EXE.

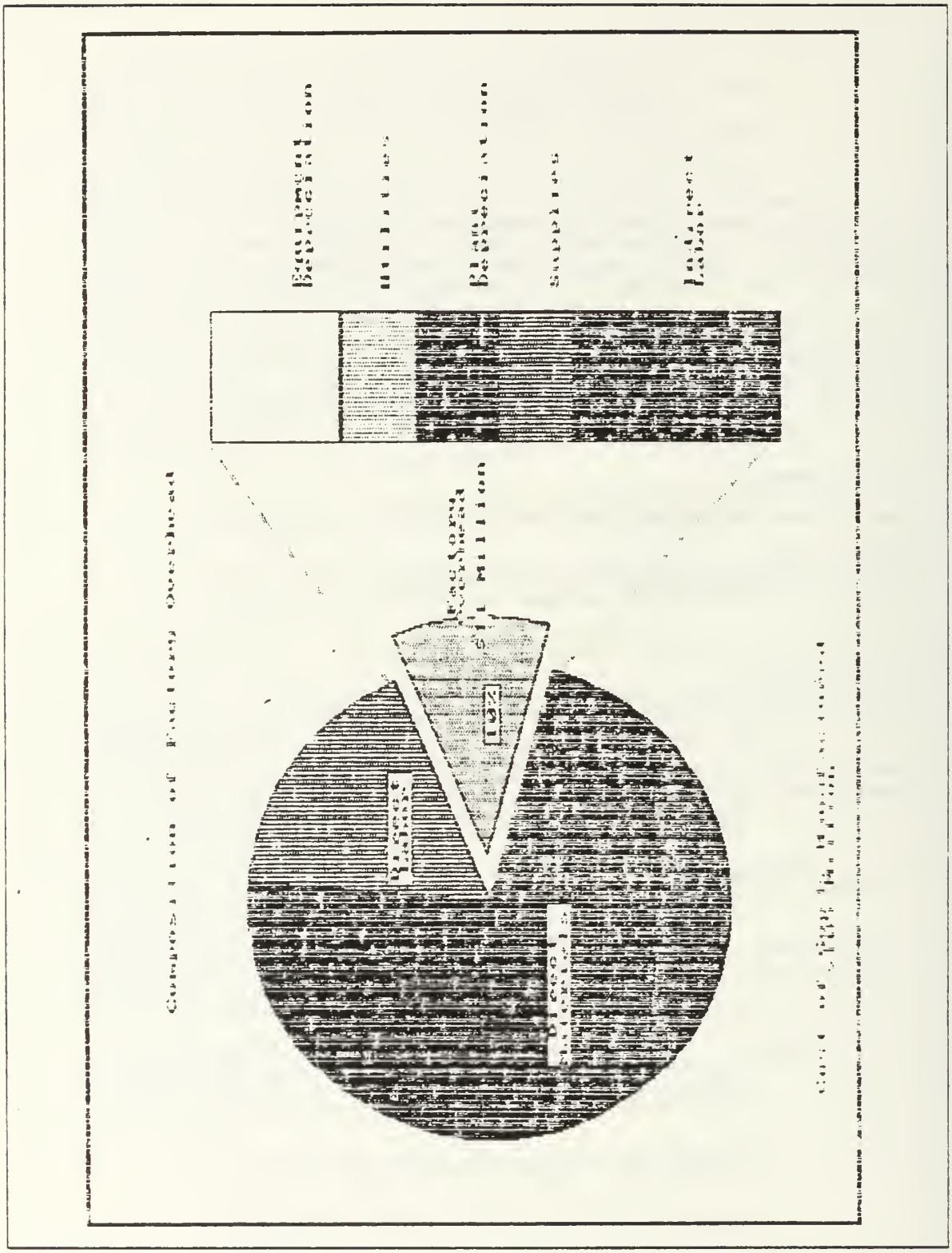


Figure 3.24 Microsoft Chart Graphics.

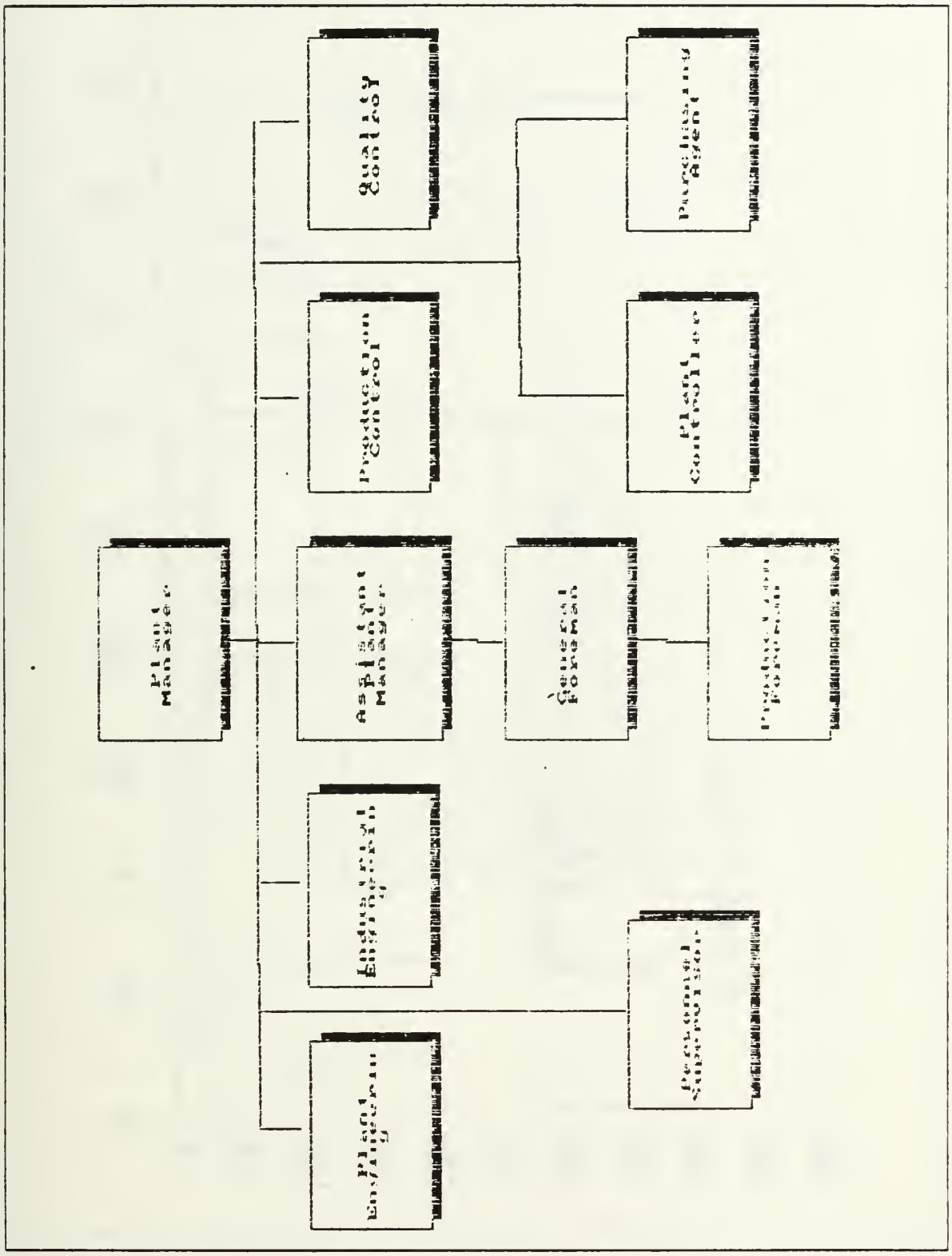


Figure 3.24 Microsoft Chart Graphics. (cont'd.)

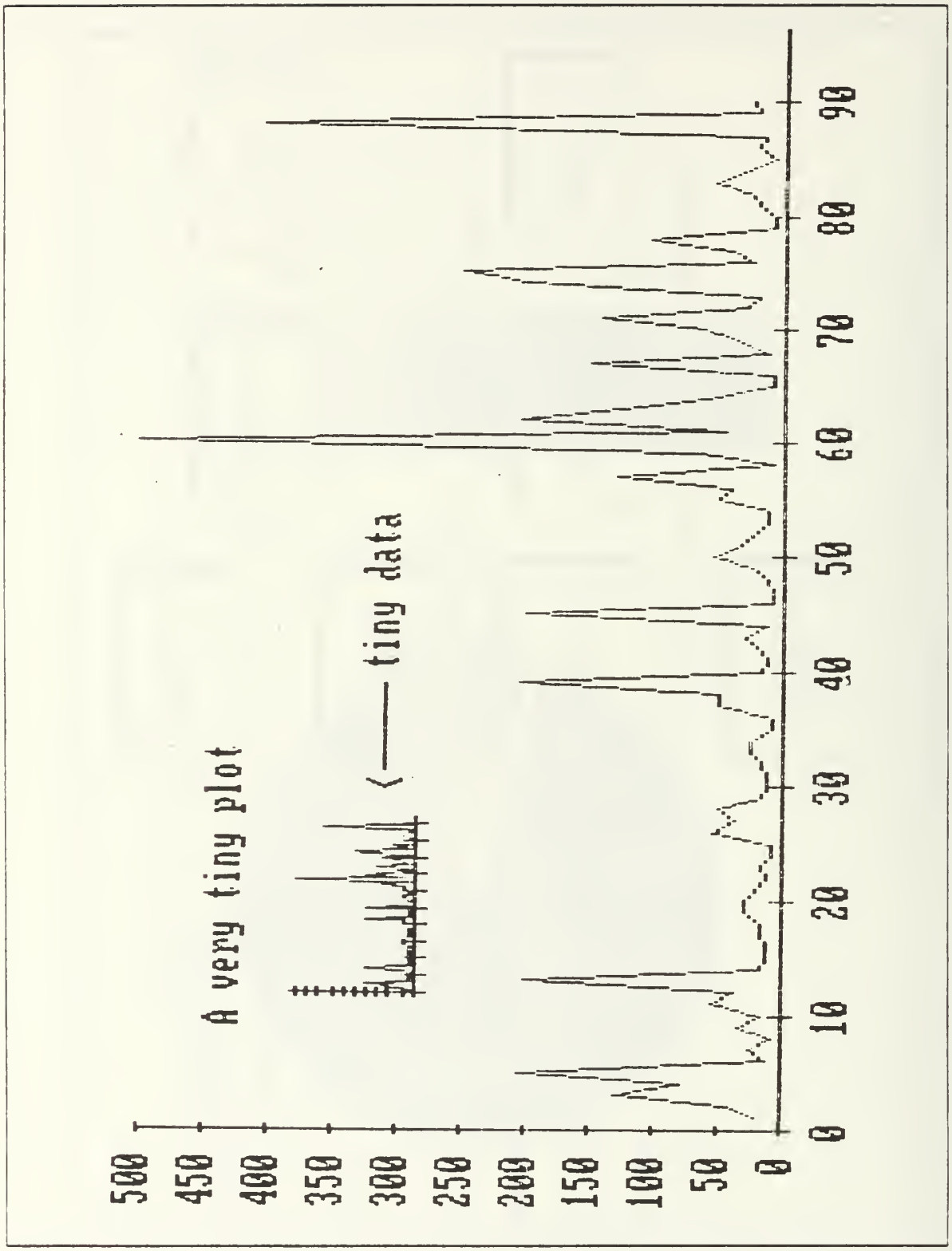


Figure 3.25 PC-Graph Graphics.

```
                    MENU OF PCPM OPTIONS

EXIT PCPM SYSTEM                                    - 0
INFORMATION                                         - 1
ENTER/CHANGE SUBCONTRACTOR/COMMENT FILE             - 2
ENTER/CHANGE INPUT FILE                             - 3
CREATE/CHANGE HOLIDAYS                              - 4
PERFORM CRITICAL PATH ANALYSIS                      - 5
PERFORM CASH FLOW ANALYSIS                          - 6
PRODUCE BAR CHARTS                                  - 7
SORT OUTPUT                                         - 8
EXTRACT OUTPUT BY SUBCONTRACTOR                     - 9
CHECK NODE NUMBERS                                  - 10
GET PRECEDENCE OR SUCCEEDENCE DISPLAY               - 11
CONVERT WORKING DAYS TO PROJECT DAYS                - 12
GENERATE CURRENT COST REPORT                        - 13
CHANGE ALL NODE NUMBERS                             - 14
CONSOLIDATE UPDATE FILES TO INPUT FILES             - 15

CHOOSE THE ACTION BY ENTERING THE CORRECT INTEGER
```

Figure 3.26 PC Project Manager Main Menu.

FINANCIAL REPORT
NAVAL AUDIT SERVICE HEADQUARTER REGION
Month Ending: 30 JUN 86

Signature _____

	(1)	(2)	(3)	(4)	(5)	(6)
	June 86 estimate	Cumulative est thru 30 June 86	Adustments to prior obligations	Actual June 86 obligations	Cumulative actual obligations thru 30 Jun	Reimbursable earned for +
C(1) Audit	$50,000	$750,000		$46,000	$735,000	
(2) Local	$500	$10,000		$300	$8,000	
(3) Training	$1,000	$100,000		$1,100	$88,000	
(4) PCS	$0	$225,000		$50	$120,000	
(5) Other	$250	$30,000		$100	$33,000	
C-Travel Subtotal	$51,750	$1,115,000	$0	$47,630	$984,000	$0
T(1) Other	$0	$250		$0	$35	
T-Trans. of things Subtotal	$0	$250	$0	$0	$35	$0
R(1) Utilities	$2,500	$15,000		$2,650	$16,250	
(2) Other Equip.	$100	$600		$0	$310	
(3) Other	$25	$150		$0	$60	
R-Rent and Utilities Subtotal	$2,625	$15,750	$0	$2,650	$16,540	$0
S(1) Computer Svcs.	$4,200	$25,200		$3,850	$26,200	
(2) Rep/Alt & Maint.	$800	$5,200		$770	$7,000	
(3) Storage of HHG	$3,000	$120,000		$2,850	$20,000	
(4) Other	$365	$1,500		$0	$425	
S-Pur/Contract Svcs. Subtotal	$8,365	$131,500	$0	$7,470	$53,425	$0
U1(1) Overtime	$80,000	$500,000		$50,000	$497,000	
(2) Lump Sum	$33,000	$200,000		$18,000	$125,000	
(3) FPD	$12,500	$75,000		$6,500	$44,000	
(4) Other	$3,500	$22,000		$1,750	$21,000	
U1-Salaries Subtotal	$129,000	$797,000	$0	$76,250	$687,000	$0
U2(1) PCS	$11,250	$135,000		$10,950	$165,000	
(2) COLA	$11,500	$70,000		$12,200	$58,000	
(3) Other	$850	$5,000		$700	$3,000	
U2-Benefits Subtotal	$23,600	$210,000	$0	$23,850	$225,000	$0
Equipment-Subtotal	$3,000	$25,000		$3,000	$24,000	
Printing-Subtotal	$10,000	$65,000		$9,875	$63,695	
Total	$229,140	$2,359,500	$0	$170,925	$2,055,195	$0

Comments:
Present 2168-1 - Cumu Oblig. + Reimb. = Avail. Bal

Figure 3.27 Budget.

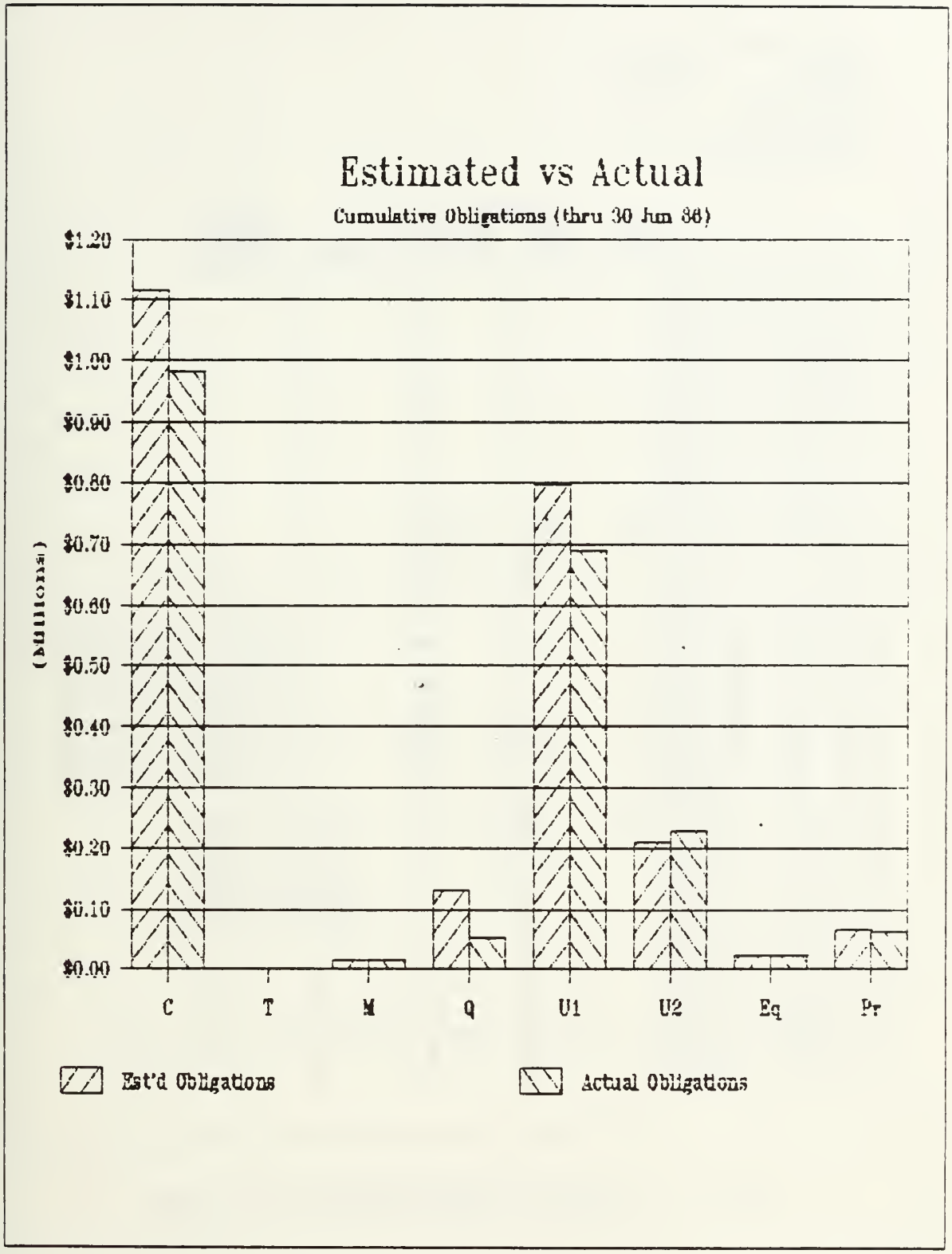


Figure 3.28 Budget Graph.

CLASSIFICATION:
Activity: Audit Nr:
Auditor: Reviewer:
Date prepared:
Period from: to:
Information source:
Audit scope:

NIIN	U/I	STORAGE LOCATION(S)	QUANTITY PER RECORDS	QUANTITY ACTUAL ON-HAND	QUANTITY DIFFERENCE	COUNT MATCHES RECORDS
00 500 2545	EA	A00929	2	1	1	
01 941 4728	EA	A09875	41	40	1	
01 517 1904	EA	A10923	12	11	1	
01 239 9977	EA	A12005	3	3	0	1
01 108 4727	EA	A50175	21	21	0	1
00 594 1559	EA	A88659	1	0	1	
00 505 3229	EA	B00023	25	25	0	1
00 797 0775	EA	B10234	1	2	-1	
01 757 4613	EA	B76925	1	1	0	1
01 119 1227	EA	B86435	88	88	0	1
01 872 4489	EA	B98875	1	1	0	1
01 086 4139	DZ	B99900	3	3	0	1
01 398 3111	BL	BARGE 204	1500	1500	0	1
00 699 1866	GL	BARGE 251	120000	120000	0	1
01 880 4773	PG	C00234	48	48	0	1
00 545 791	EA	C12592	15	15	0	1
00 177 1348	EA	C76098	1	0	1	
00 005 3207	EA	C76876	2	2	0	1
00 092 4788	EA	C90001	144	72	72	
00 073 9089	EA	C98045	9	9	0	1
01 931 1053	EA	D00004	32	32	0	1
01 632 985	EA	D00598	1	1	0	1
01 853 5088	EA	D09128	1	1	0	1
01 523 1690	EA	D75002	500	500	0	1
01 936 3630	EA	D75006	125	125	0	1
00 931 3101	EA	D88945	1	1	0	1
01 124 5556	EA	D90012	19	20	-1	
01 540 8760	DR	DRUM LOT 1	55	55	0	1
00 434 8691	DR	DRUM LOT 2	65	65	0	1
00 178 218	CS	E00102	16	16	0	1
01 321 3185	EA	E1234U	6	6	0	1
00 308 1616	EA	E59590	2	8	-6	
01 683 5334	EA	E67854	1	2	-1	
00 300 5928	EA	E88945	10	10	0	1
01 032 7671	EA	F20134	1	1	0	1
00 045 3211	EA	F49087	1	1	0	1
00 573 1945	EA	F56210	5	5	0	1
01 591 4164	EA	F75980	45	45	0	1
01 769 6870	EA	F99345	1	1	0	1
00 318 4380	EA	H1250L	4	5	-1	
01 045 2809	EA	H34512	71	71	0	1

Figure 3.29 Completed Inventory Verification Work Paper.

01 143 3999	EA H51230	7	7	0	1
00 139 6633	EA H52315	80	80	0	1
00 503 7237	EA H87905	1	1	0	1
00 857 2304	OZ VAULT	72	72	0	1
00 927 4494	SE WHSE 1	2	2	0	1
01 068 2060	PR WHSE 1	36	36	0	1
00 980 9639	EA WHSE 1	100	100	0	1
00 438 9971	EA WHSE 2	50	50	0	1
00 738 4752	EA WHSE 2	8	8	0	1

Inventory Validity	78.00%
Sample Size	50
# Count = Record	39
# Count <> Record	11
Std Qty Deviation	10
Avg Qty Difference	1

Figure 3.29 Completed Inventory Verification Work Paper. (cont'd.)

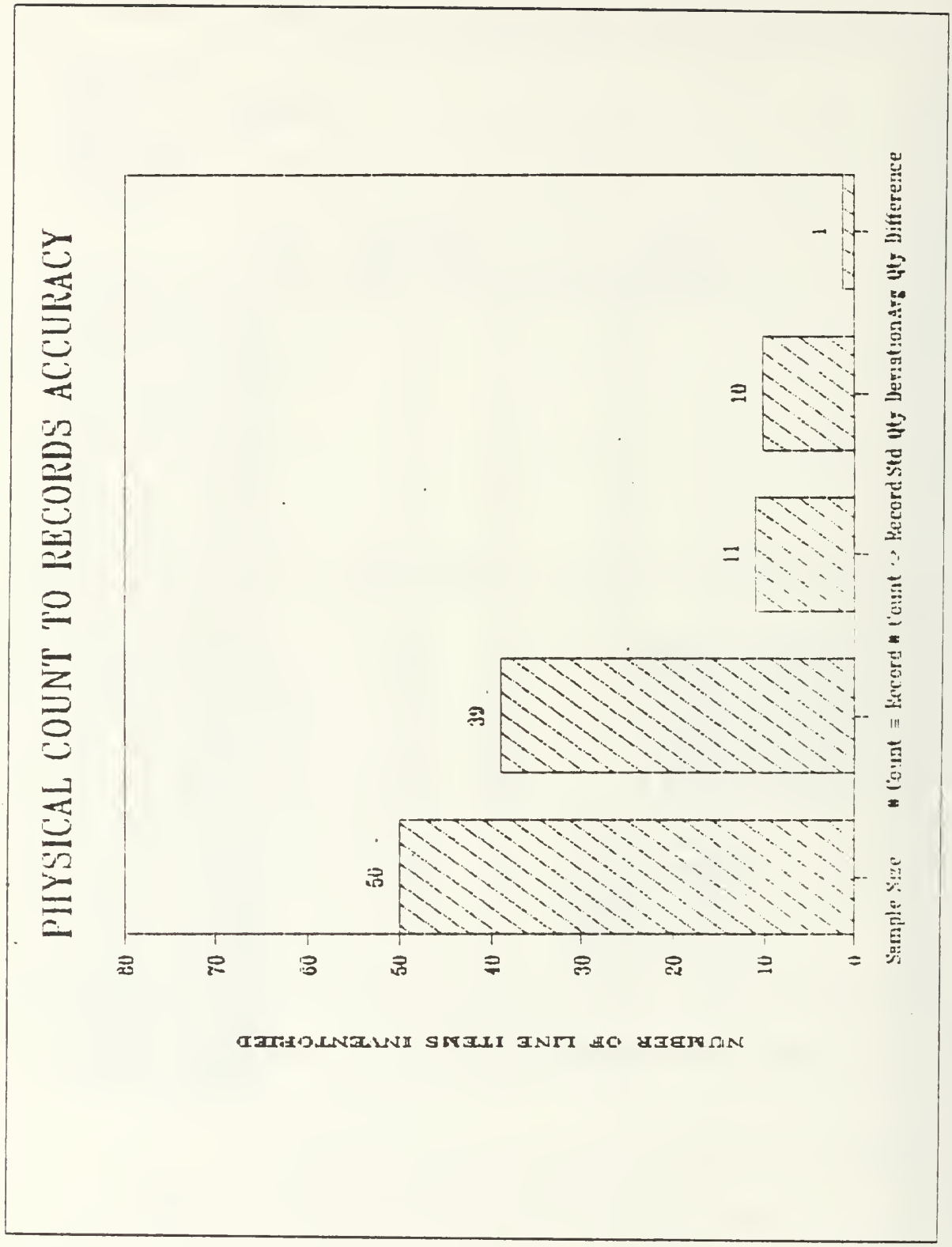


Figure 3.30 Graphic Display of Inventory Analysis.

Figure 3.31 Sidekick Main Menu.

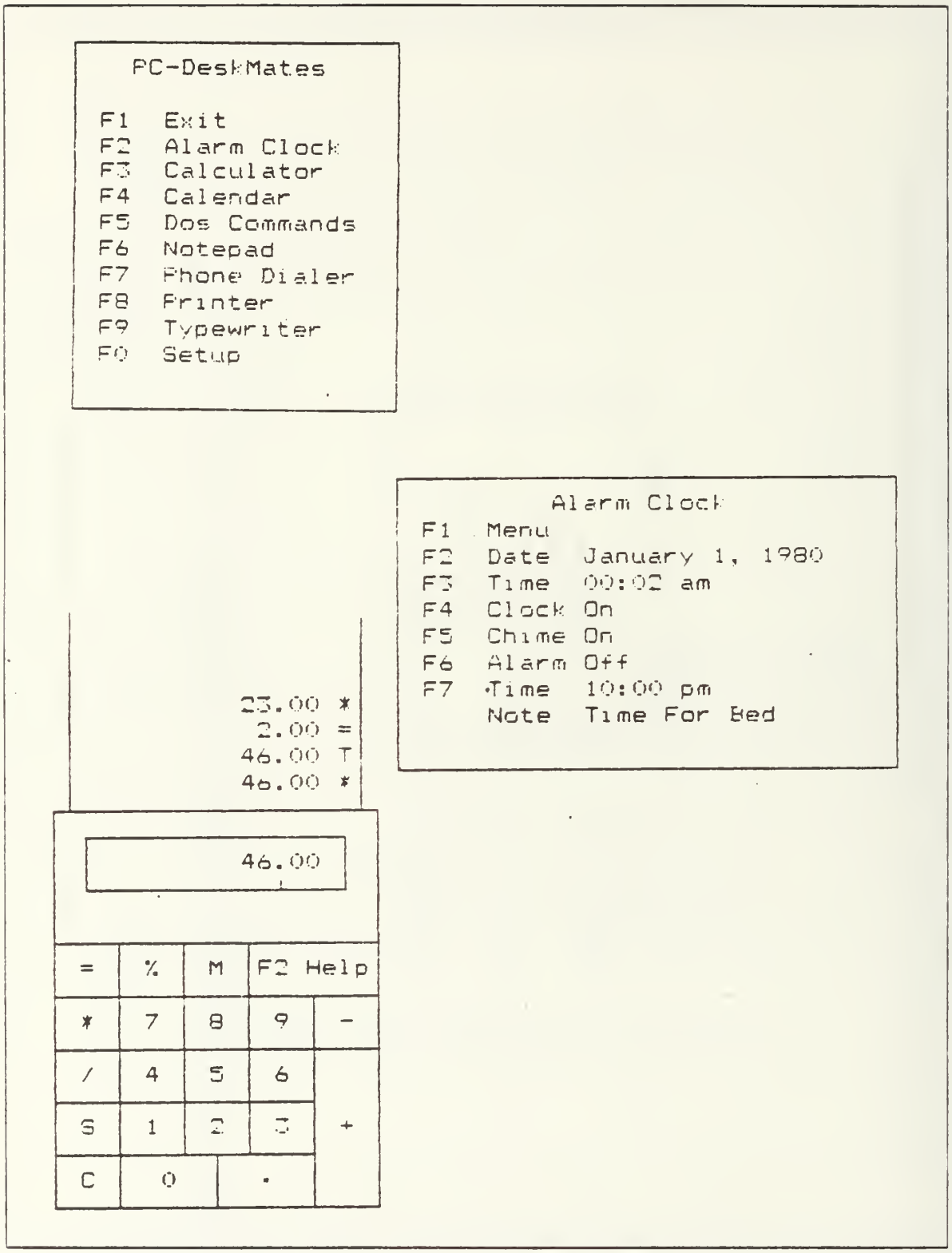


Figure 3.32 PC-Deskmate Main Menu, Alarm Clock, and Calculator.

Figure 3.33 PC-Deskmate Typewriter.

APPENDIX C

PRIVATE INDUSTRY AND FEDERAL GOVERNMENT SURVEY PARTICIPANTS

TABLE 26

AUDIT ORGANIZATIONS SURVEYED

	NAME
1.	American President Companies
2.	BankAmerica Corporation
3.	Bergen Brunswig Corporation
4.	Bechtel Power Corporation
5.	Carnation Company
6.	Castle & Cooke Incorporated
7.	Chevron Services Company
8.	Del Monte Corporation
9.	Deloitte Haskins & Sells
10.	Di Giorgio Corporation
11.	First Interstate Bankcorp
12.	Grant Thornton
13.	Hilton Hotels Corporation
14.	Kaiser Aluminum & Chemical Corporation
15.	KMG Main Hurdman, CPA's
16.	Laventhol & Horwath
17.	Lear Siegler Incorporated
18.	Levi Strauss & Company
19.	Mattel Incorporated
20.	MCA Incorporated
21.	Mervyns
22.	McKesson Corporation
23.	National Semiconductor
24.	Nothrup Corporation
25.	Occidental Petroleum Corporation
26.	Pacific Gas & Electric Company
27.	Pacific Lighting Corporation
28.	Pacific Telesis Group
29.	Peat, Marwick, Mitchell Company
30.	Price Waterhouse & Company

TABLE 26

AUDIT ORGANIZATIONS SURVEYED (CONT'D.)

31. Sante Fe International Corporation
32. Security Pacific Corporation
33. Southern Pacific Transportation Company
34. Touche Ross & Company
35. Union Bankcorp
36. United States Air Force, Air Force Audit Agency
37. United States Department of Agriculture, Office of Inspector General
38. United States Department of Defense, Office of Inspector General
39. United States Department of Labor, Office of Inspector General
40. United States Department of Transportation, Office of Inspector General
41. Utah International Incorporated
42. Walt Disney Company
43. Whittaker Corporation

APPENDIX D
THESIS SURVEY QUESTIONNAIRES

TABLE 27

PRIVATE INDUSTRY AND FEDERAL GOVERNMENT QUESTIONNAIRE

THESIS QUESTIONNAIRE

Instructions: Check appropriate responses for each question. More than one response may be checked for several questions. In addition, add comments where appropriate.

1. Types of audits performed

   a. Financial
   b. Operational
   c. Special studies requested by management

2. Functional areas reviewed in Operational audits

   a. Personnel
   b. Timekeeping
   c. Supply/Inventory
   d. Warehousing
   e. Payroll
   f. Budgeting
   g. Cash Management
   h. Disbursement/Bill Paying
   i. Contracting/Procurement
   j. Fixed Assets
   k. Maintenance and Repair
   l. Manufacturing and Production
   m. Transportation
   n. Communications
   o. Data Processing
   p. Other (List)

TABLE 27

PRIVATE INDUSTRY AND FEDERAL GOVERNMENT QUESTIONNAIRE (CONT'D.)

3. Audit program usage
(Indicate percentage of use. Modification or partial completion of standard programs should be included under standard program use.)

a. In what percentage of audit applications are standard audit programs used?

76% - 100%
51% - 75%
26% - 50%
1% - 25%
Never

b. In what percentage of audit applications are unique audit programs developed for audits?

76% - 100%
51% - 75%
26% - 50%
1% - 25%
Never

4. Microcomputer applications

a. Electronic Workpapers
b. Report Writing
c. Audit Management
d. Data Analysis
e. Statistical Sampling
f. Audit Presentations
g. Graphics
h. Telecommunications
i. Other (List)

5. Audit software

a. Are standard software packages used?

b. Are custom audit programs written using high level programming languages such as COBOL, BASIC, and PASCAL?

c. If answer to b. is yes please give a general description of the programs developed.

TABLE 27

PRIVATE INDUSTRY AND FEDERAL GOVERNMENT QUESTIONNAIRE (CONT'D.)

d. Commercial software used

	Type	Name
1)	Word Processing	
2)	Spreadsheet	
3)	Graphics	
4)	Project Management	
5)	Data Base	
6)	Accounting	
7)	Utilities	
8)	Telecommunication	
9)	Statistics	
10)	Integrated Packages	
11)	Other (List)	

6. Who uses microcomputers

a. All Auditors
b. EDP Auditors only
c. Specially trained auditors
d. Audit managers
e. Technical specialists
f. Reviewers

7. Where are microcomputers used

a. On-Site (i.e. Portables)
b. HQ/ Audit Office

8. Please add any other comments concerning your use of microcomputers in the audit function which you think are appropriate or of interest for our study.

TABLE 28

NAVAL AUDIT SERVICE QUESTIONNAIRE

THESIS QUESTIONNAIRE FOR NAVAL AUDIT SERVICE

OPNAV Report Control Symbol: RCS-7510-01

Instructions: Check appropriate responses for each question. More than one response may be checked for several questions. Please, add comments where appropriate.

1. Position:

   a. Auditor
   b. Auditor in Charge

2. How long have you had the microcomputer at your site.

   a. Less Than 3 Months
   b. 3 - 6 Months
   c. 6 - 9 Months
   d. 9 - 12 Months
   e. Greater than 12 Months

3. List your previous experience with using microcomputers.

   a. None
   b. Previous job
   c. College
   d. Home (have your own PC)

4. Audit usage information

   a. List the functional areas for which microcomputers were used.
      (Use functional area identification numbers from timesheet)

   b. List the Naval Audit Service audit programs used to review these functional areas. Indicate the audit program number and where possible the specific audit step number.

Program Number	Step Number	Software Used

TABLE 28

NAVAL AUDIT SERVICE QUESTIONNAIRE (CONT'D.)

c. Can these applications be used for other audits?

1. Yes, the next time this audit is performed (same activity)
2. Yes, for audits of the same type of activity.
3. Yes, everytime this audit program step is performed.
4. Unable to determine at this time.
5. No

5. Applications which the microcomputers were used for.

a. Electronic Workpapers
b. Word Processing (Draft findings, survey debriefs, etc.)
c. Audit Management (Audit planning, personnel management etc.)
d. Data Analysis (Speadsheets, data base)
e. Statistical Sampling
f. Audit Presentations
g. Graphics
h. Telecommunications
i. Other (List)

6. Identify the benefits (if any) from using the microcomputer for these applications.

a. Better looking output
b. Enhanced reliability in statistical sampling
c. Enhanced reliability of data analysis
d. Less time spent on repetitive tasks
e. Ability to review larger amounts of data
f. Other (List)

7. Were there any applications that you wanted to do but were unable to?
(Please give a general description of them.)

8. How do you think Naval Audit Service should integrate microcomputers into day to day operations?

a. Headquarters should develop standard software applications for audit program steps and administrative tasks.
b. Users should develop their own applications and distribute them to other auditors via a NAS computer newsletter or an electronic bulletin board.
c. Standard routines should be developed for repetitive administrative tasks but audit applications should be developed each time an audit is performed.
d. Other

TABLE 28

NAVAL AUDIT SERVICE QUESTIONNAIRE (CONT'D.)

9. List any other software programs or types of programs you think Naval Audit Service should purchase for the microcomputers.

10. What is your biggest problem in using microcomputers?

a. Lack of formal training
b. Reliability of hardware
c. Poor software documentation
d. Access to a free machine
e. Time required to learn how to use it
f. Developing the right application
g. Other (Describe)

11. What is your opinion of the potential level of microcomputer use for audit and administrative tasks?

	Audit Tasks	Administrative Tasks
a.	High	High
b.	Medium	Medium
c.	Low	Low

APPENDIX E
SOFTWARE DEVELOPMENT ORGANIZATIONS

American Business Systems Inc
3 Littleton Rd
Westford MA 01886

Applied Microsystems, Inc.
P.O. Box 832
Roswell GA 30077

Applied Operations Research
22056 Saticoy St.
Canoga Park CA 91303

Ashton-Tate
10150 W Jefferson Bl
Culver City CA 90230

Best Programs
5134 Leesburg Pike
Alexandria VA 22302

Data Consulting Group
12 Skylark Dr. #18
Larkspur CA 94939

Data Easy
12 Skylark Dr. #18
Larkspur CA 94939

DataSource Systems
7450 Washington Av S
Eden Prairie MN 55344

Ferox Microsystems Inc.
1701 N Fort Myer Dr.
Sixth Floor
Arlington VA 22209

Fox & Geller, Inc.
604 Market St.
Elmwood Park NJ 07666

Gavel Computing Systems, Inc.
Rt. 2, Box 466
Alacual FL 32615

Glenco Engineering
3920 Ridge Ave.
Arlington Heights IL 60004

Hemming Morse, Inc.
1700 S ElCamino Real, #320
San Mateo CA 94402

LWFW, Inc. Group
12700 Park Central
1805
Dallas TX 75251

Lotus Development Corp
161 First Street
Cambridge MA 02142

Micro Decision Systems
P.O. Box 1392
Pittsburgh PA 15230

Microrim, Inc.
3380 146th Pl. SE
Bellevue WA 98007

Microsoft
10700 Northrup Way
Box 97200
Bellevue WA 98004

Pacesetter Software
P.O. Box 5270
Princeton NJ 08540

Personal Software Company
P.O. Box 776
Salt Lake City UT 84110

Simple Software, Inc.
2 Pinewood
Irvine CA 92714

Sophco, Inc.
P.O. Box 7430
Boulder CO 80306

Stok Software, Inc.
17 W. 17th Street
New York NY 10011

Systems Plus, Inc.
1120 San Antonio Rd
Palo Alto CA 94303

The Futures Group
76 Eastern Blvd
Glastonbury CT 06033

Trigram Systems
3 Bayard Rd. #66
Pittsburgh PA 15213

Westminster Sofware, Inc.
660 Hansen Way #2
Palo Alto CA 94304

William A. Permar & Assoc.
1125 Sunnyhills Rd
Oakland CA 94610

LIST OF REFERENCES

1. U.S. Department of Defense, Secretary of the Navy Instruction 7510.7C, *Department of the Navy Audit Manual for Management*, p. 1, 13 March 1986.

2. Keen, P.G.W., and Morton, M.S.S., *Decision Support Systems: an Organizational Perspective*, Addison-Wesley Publishing Company, Inc., 1978.

3. Stoner, J.A.F., *Management*, 2d ed., Prentice-Hall, 1982.

4. Thomas, J.M., and Bennis, W.G., *The Management of Change and Conflict*, Penguin Books, 1979.

5. Tichy, N.M., *Managing Strategic Change - Technical, Political, and Cultural Dynamics*, John Wiley & Sons, Inc.,1983.

6. Weick, K., *Educational Organizations as Loosely Coupled Systems*, Administrative Science Quarterly, 1976.

7. Galbraith J., *Designing Complex Organizations*, Addison-Wesley Inc., 1973.

8. Beckhard, R., and Harris, R., *Organizational Transitions: Managing Complex Change*, Addison-Wesley, 1977.

9. Freedman, D.H., "Team Up to Plan Office Automation," *Infosystems*, pp. 82-83, February 1984.

10. Price Waterhouse, *Managing Microcomputers: A Guide for Financial Policymakers*, National Association of Accountants, 1984.

11. Bright, J.R., *Automation and Management*, The Plimpton Press, 1957.

12. Nance, H.W., and Nolan, R.E., *Office Work Measurement*, McGraw-Hill, Inc., 1971.

13. U.S. Department of Defense, Directive 7600.7M, *Chapter 11-Advanced Audit Techniques Part III Computer Assisted Audits*, pp. 1-26, Government Printing Office, Washington, DC, 31 October 1983.

14. Naval Audit Service Western Region Memorandum, *NAVAUDSVCWEST FY 1987 Microcomputer Applications by Audit.*

15. U.S. General Accounting Office, Information Management and Technology Division, *Using Micro Computers in GAO Audits: Improving Quality and Productivity (Technical Guideline 1)*, Government Printing Office, Washington, DC, March 1986.

16. U.S. Department of Defense, Department of the Navy, Office of The Auditor General of the Navy, *Naval Audit Handbook (NAVAUDSVC P-7520.1)*, Navy Publication and Printing Service, Falls Church, VA, 1985.

17. Naval Audit Service Management Information System Report 19B, *Accumulated Man-Hours by Audit Type*, p. 1, 27 September 1986.

18. Naval Audit Service Management Information System Report 12B, *Application of Total Time All Regions*, Schedule C, 27 September 1986.

19. Tharrington, J.M., "Introducing Microcomputers Successfully," *Infosystems*, pp. 44-45, March 1984.

20. U.S. Department of Defense, Directive 7920.1, *Life Cycle Management of Automated Information Systems (AIS)*, p. 2, Government Printing Office, Washington, DC, 17 October 1978.

21. Mazursky, Alan D., "Staffing the Microcomputer Resource Center," *Journal of Information Systems Management*, Vol.1, No. 4, p. 74, Fall 1984.

22. Rosenthal, M., "Careful Software Evaluation Increases End User Acceptance," *Data Management*, September 1985.

23. Sprague, R.H., Jr., and Carlson, E.D., *Building Effective Decision Support Systems*, Prentice Hall, 1982.

24. U.S. General Accounting Office, *Comprehensive Audit Manual*, Government Printing Office, Washington, DC, 1978.

25. Hemming Morse Inc. Letter, *Focus:ABC Audit*, 1 July 1986.

26. Ford, N., *DISKCAT(tm) version 4.0 Disk File Catalog Program*, DISKCAT Operations Manual (unpublished), Houston, TX, 1984.

27. American Institute of Certified Public Accountants, *Auditors' Use of Microcomputers*, AICPA, 1986.

28. Thomas, A.L., "Use of Microcomputer Spreadsheet Software in Preparing and Grading Complex Accounting Problems," *The Accounting Review*, October 1983.

29. PC World Publishing, *PC World 1985 Annual Software Review*, 1985.

30. Meigs, W.B., Larsen, E.J., and Meigs, R.F., *Principles of Auditing*, 5th ed., Richard D. Irwin, Inc., 1973

31. Beitman, L., Beitman, L., "Microcomputers in the Audit Function," *EDPACS*, 1984.

32. Willits, S.D., and McCoslin, T.E., "Micro Simplifies Dollar-Unit Sampling," *The Internal Auditor*, June 1985.

33. Brock, T.L., "Multiple Regression On Lotus 1-2-3," *Journal of Accountancy*, July 1986.

34. U.S. Department of Defense, Department of the Navy, Office of The Auditor General of The Navy, *Naval Audit Management Handbook (NAVAUDSVC P-5210.1A)*, Navy Publication and Printing Service, Falls Church, VA, 1985.

35. Friel, J., *Omodem Operations Manual Version 1.03-C*, by the Forbin Project, Cedar Falls, Iowa, p. 1, 26 March 1985.

36. U.S. Department of Commerce, National Bureau of Standards, Federal Information Processing Standard 41, *Computer Security Guidelines for Implementing The Privacy Act of 1974*, Government Printing Office, Washington, DC, 30 May 1975.

37. U.S. Department of Commerce, National Bureau of Standards, Federal Information Processing Standard 46, *Data Encryption Standard*, Government Printing Office, Washington, DC, 15 January 1977.

38. U.S. Department of Defense Directive 5200.28, *Security Requirements for Automated Data Processing (ADP) Systems*, Government Printing Office, Washington, DC, 18 December 1972.

39. American Institute of Certified Public Accountants, *Codification of Statements on Auditing Standards: Numbers 1 to 44*, Commerce Clearing House, Inc., p. 51, 1983.

40. U.S. Department of Defense, Department of the Navy, Commander Navy Accounting and Finance Center, Staff Report, *Internal Control Information System*, undated.

41. Neuman, F., "How DCAA uses Risk Analysis in Planning & Programming Audits," *The Internal Auditor*, pp. 32-39, June 1979.

42. Shepard, L., *Personal Computer Project Management: User Manual*, (unpublished), Sacramento, CA, 21 November 1984.

43. Fox and Geller, *Management Control*, Letter, undated.

44. Dickinson, J., "The Business of Words," *PC Magazine*, Vol. 5 No. 2, pp. 93-99, 28 January 1986.

45. Starr, W., and Murch, M., "Notes From the Underground WordStar," *PC Magazine*, Vol. 5 No. 2, p. 258, 28 January 1986.

46. Petzold, C., "MultiMate 3.3 Series Professional Word Processor 3.31," *PC Magazine*, Vol. 5 No. 2, pp. 113-114, 28 January 1986.

47. Dreger, C.H., *The Complete Guide to MultiMate*, Sybex, Berkeley, 1984.

48. Stinson, C., "Microsoft Word 2.0," *PC Magazine*, Vol. 5 No. 2, pp. 148-150, 28 January 1986.

49. Jones, E., *Using dBASE III*, Osborne McGraw-Hill, 1985.

50. Button, J., *PC-FILE A Database Manager Program for the IBM Personal Computer*, User Manual (unpublished), p. 1, 1983.

51. Dyar, C.,"PC-File III," *PC Magazine*, Vol. 5 No. 14, pp. 294-295, August 1986.

52. Deposito, J., "Infostar Plus," *PC Magazine*, Vol. 5 No. 14, pp. 290-291, August 1986.

53. Hart, G.,"dBASE III Plus," *PC Magazine*, Vol. 5 No. 12, pp. 125-126, 24 June 1986.

54. Datapro Reports on Microcomputers CM99-501-091, Vol. 2 No. 9, *Microrim R:base 5000*, by Datapro Research Corporation, September 1985.

55. Willmott, D.,"The First PC," *PC Magazine*, Vol. 5 No. 17, p. 126, 14 October 1986.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Technical Information Center Cameron Station Alexandria, Virginia 22304-6145	2
2.	Library, Code 0142 Naval Postgraduate School Monterey, California 93943-5002	2
3.	Defense Logistics Studies Information Exchange U.S. Army Logistics Management Center Fort Lee, Virginia 23801-6043	1
4.	Dr. James M. Fremgen, Code 54Fm Naval Postgraduate School Monterey, California 93943-5000	1
5.	Dr. Tung X. Bui, Code 54Bd Naval Postgraduate School Monterey, California 93943-5000	1
6.	Mr. Tracy A. LaPoint Naval Audit Service Capital Region 1941 Jefferson Davis Highway Crystal Mall #4, Room 325 Washington, D.C. 20376	1
7.	LCDR Michael Augustine, SC, USN Navy Fleet Material Support Office P.O. Box 2010 Mechanicsburg, Pennsylvania 17055	2
8.	Dr. Dwight M. Carter, Code 15 Naval Audit Service Headquarters NASSIF Building P.O. Box 1206 5611 Columbia Pike Falls Church, Virginia 22041	2
9.	Computer Technology, Code 37 Naval Postgraduate School Monterey, California 93943-5000	1

DUDLEY KNOX LIBRARY
NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA 93943-5002

Thesis
L2672 LaPoint
c.1 Survey and recommendations for the use of microcomputers in the Naval Audit Service.

Thesis
L2672 LaPoint
c.1 Survey and recommendations for the use of microcomputers in the Naval Audit Service.

thesL2672
Survey and recommendations for the use o
3 2768 000 72690 5
DUDLEY KNOX LIBRARY